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Stomatopod Crustacea from West Pakistan

By Nasima M. Tirmizi and Raymond B. Manning[1]

Introduction

As part of a broad program of studies on the larger Crustacea of West Pakistan and the Arabian Sea, one of us (N.T.) initiated a survey of the Stomatopoda occurring off the coast of West Pakistan. Analysis of preliminary collections indicated that the stomatopod fauna of this area is richer in numbers of species than is evident from the literature. Through correspondence in 1966, we decided to collaborate on a review of the Pakistani stomatopods; this report is the result of that collaboration.

This paper is based primarily on collections made by and housed in the Zoology Department, University of Karachi. Specimens in the collections of the Central Fisheries Department, Karachi, and the Zoology Department, University of Sind, were also studied. Unfortunately, only a few specimens from the more extensive stomatopod collections of the Zoological Survey Department, Karachi, were available for study. Material from Pakistan in the collection of the Division of Crustacea, Smithsonian Institution (USNM), material from two stations made off Pakistan by the International Indian

[1] Tirmizi: Reader, Zoology Department, University of Karachi, Pakistan; Manning, Chairman, Department of Invertebrate Zoology, Smithsonian Institution.

Ocean Expedition (IIOE), and a few specimens in the collections of the British Museum (Natural History) (BMNH), are also recorded.

Some species of stomatopods are edible and are relished in various parts of the world. Baig (1954) noted that in Karachi certain people used them for food; however, we learned from fishermen that these animals are considered as "fish lice" and as such are regarded as unfit for human consumption. Large quantities are caught in fishermen's nets and are sold cheaply along with fish-waste to be used as fertilizer or poultry food.

ACKNOWLEDGMENTS.—This study could not have been completed without the help of many individuals and institutions. The Foreign Currency Program of the Smithsonian Institution made it possible for one of us (R.B.M.) to visit West Pakistan, and preparation of some of the illustrations by Lilly Manning was supported by the Smithsonian Research Awards Program. Mr. Robert A. Dietchman and E. J. D'Souza, on the staff of the American Embassy in Karachi, expedited all administrative matters pertaining to the visit to Karachi. Dr. M. A. H. Qadri, Chairman, the Department of Zoology, University of Karachi, kindly made the departmental facilities available to us. Mr. S. S. U. Siddiqui, Officer-in-charge, Zoological Survey Department, Karachi, allowed one of us (N.T.) to study some of the stomatopods from that collection. Mr. Agha Ghulam Hussain, Director, Marine Fisheries Department, Karachi, allowed us to work with all of the stomatopods in his collection. Dr. A. L. Rice and Mr. R. W. Ingle, Crustacea Section, British Museum (Natural History), provided working space for one of us (R.B.M.) and loaned us several specimens for additional study. Miss Quddosi Bashir was most helpful in preparing the specimens for study and in composing the plates.

LITERATURE SURVEY.—Although 40 species of stomatopods are known to occur in the northwestern Indian Ocean, between Bombay and the Red Sea (see table, p. 4), only 11 of these have been recorded from the coastal waters of West Pakistan. Kemp (1913) reported eight species from Karachi: *Squilla microphthalma*, (*) *S. scorpio*, *S. scorpio* var. *immaculata*, *S. nepa*, (*) *S. interrupta*, *S. raphidea*, (*) *Gonodactylus chiragra*, and *G. demanii*. Baig (1954) recorded the three species marked with as asterisk and *Lysiosquilla maculata* as well, and Tirmizi (1967) reported specimens of *Protoquilla lenzi* and *P. pulchella*, so that 11 species were known from West Pakistan.

Our collections include 17 species, and it seems highly likely that additional collecting in specific habitats with specialized techniques could yield numerous additional species. For example, one collection made off Astola Island with rotenone during the International Indian Ocean Expedition yielded six different species, including one specimen

of an undescribed species of *Manningia*, previously known only from the Gulf of Aden. Additional collecting in such habitats could result in the collection of other species of *Gonodactylus*, *Protosquilla*, and *Pseudosquilla* as well. Other species could be expected to occur offshore in deeper water.

ZOOGEOGRAPHICAL NOTES.—Our knowledge of the stomatopods of the Indian Ocean is still so fragmentary that only preliminary observations can be recorded here. The distribution of the 46 species of stomatopods from the northwestern Arabian Sea is tabulated below (data are from Kemp, 1913; Chhapgar and Sane, 1968; Chopra, 1939; Holthuis, 1967b; Ingle, 1963; and Manning, 1967b). Records for these species from Madagascar and South Africa (including southern Moçambique) (Barnard, 1950; Manning, 1969) are included for comparison. Very little is known of the stomatopods of the East African coast proper.

The fauna of the Red Sea is the best known of the areas in the northwestern Arabian Sea; 31 of the 46 species known from the latter area occur in the Red Sea. Seventeen of these species occur off West Pakistan. Habitats in the Red Sea are undoubtedly more diverse, and the greater diversity is reflected in the presence of species of *Coronida*, *Gonodactylus*, *Protosquilla*, and *Pseudosquilla* there.

Only 16 of the 46 species from the northwestern Arabian Sea occur off Madagascar, and only 12 extend as far southward as southern Moçambique and South Africa. Thirteen of the species recorded from Madagascar by Manning (1968b) and 11 of the species known from South African waters (Manning, 1969) do not occur in the northwestern Arabian Sea. The fauna, however, of the central portion of the western Indian Ocean is somewhat richer than that of either the northern or southern portions of that ocean, for approximately 60 species are known from there. A more detailed analysis of the stomatopod faunal patterns in the Indian Ocean is in preparation in a review by one of us (R.B.M.) of the stomatopods collected during the International Indian Ocean Expedition.

The stomatopod fauna of West Pakistan can be expected to be very similar to that found off Bombay, India, to the south; 17 species are now known from Bombay (Chhapgar and Sane, 1968), and only 9 of these occur off Pakistan. Shallow, muddy bottoms are a predominant coastal environmental feature along much of the eastern shore of the Arabian Sea, and there is little reason not to expect a relatively uniform stomatopod fauna throughout that area.

It seems unlikely that there are any major faunal discontinuities in the Arabian Sea proper, at least as far as the stomatopods are concerned, although some local discontinuities may exist as a result of changes in habitat. The absence of coral reefs off West Pakistan

should limit the occurrence of coral associated species, but some of these, at least, can inhabit rocky areas as well. Other than differences expected as a result of the presence or absence of reefs, the fauna of the Arabian Sea between Bombay and the Red Sea, including the Persian Gulf, can be expected to be relatively uniform. Many of the 29 species occurring in the Arabian Sea, but not now known from West Pakistan, could be expected to occur off Pakistan.

Distribution of Stomatopod Crustacea from the Northwestern Indian Ocean

	Southern Africa	*Madagascar*	*Bombay*	*West Pakistan*	*Northwestern Indian Ocean, Persian Gulf, Gulf of Oman*	*Red Sea, Gulf of Aden*
Acanthosquilla						
acanthocarpus	+	−	+	+	−	−
multifasciata	−	−	+	−	+	+
vicina	−	−	−	−	−	+
Alima						
supplex	−	−	+	−	−	−
Anchisquilla						
fasciata	−	−	−	−	−	+
Carinosquilla						
carinata	−	+	−	−	−	+
Clorida						
bombayensis	−	−	+	−	−	−
denticauda	−	−	+	−	−	−
fallax	−	+	−	−	−	+
latreillei	+	−	+	−	+	+
microphthalma	−	−	+	+	−	−
Cloridopsis						
immaculata	−	−	−	+	−	−
scorpio	−	−	+	+	−	−
Coronida						
trachura	−	−	−	−	−	+
Eurysquilla						
sewelli	−	−	−	−	−	+
Gonodactylus						
chiragra	+	+	+	+	+	+
choprai	−	−	−	−	+	+
demanii	−	+	+	+	+	+
falcatus	+	+	+	−	+	+
lanchesteri	+	+	−	+	+	+
smithii	−	+	−	+	−	+
spinosus	−	−	−	−	?	−
Harpiosquilla						
annandalei	−	−	−	−	+	−
harpax	+	+	+	+	+	+
raphidea	−	−	+	+	−	−

Distribution of Stomatopod Crustacea from the Northwestern Indian Ocean—Continued

	Southern Africa	*Madagascar*	*Bombay*	*West Pakistan*	*Northwestern Indian Ocean, Persian Gulf, Gulf of Oman*	*Red Sea, Gulf of Aden*
Leptosquilla schmeltzii	−	−	−	−	−	+
Lysiosquilla tredecimdentata	+	+	−	+	−	+
Manningia amabilis	−	−	−	+	−	+
pilaensis	−	−	+	−	−	−
Mesacturus brevisquamatus	−	−	−	−	−	+
Nannosquilla hystricotelson	+	−	−	−	−	+
Oratosquilla gonypetes	+	+	−	−	+	−
hesperia	+	+	−	+	+	+
interrupta	−	−	+	+	+	−
investigatoris	+	−	−	−	+	+
massavensis	−	−	−	−	−	+
nepa	+	+	+	+	−	+
perpensa	−	−	−	−	+	−
quinquedentata	−	−	+	−	−	−
simulans	−	−	−	−	−	+
Protosquilla lenzi	−	+	−	+	−	+
pulchella	−	+	−	+	+	+
spinosissima	−	+	−	−	−	+
Pseudosquilla ciliata	+	+	−	−	+	+
megalophthalma	−	−	−	−	−	+
Squilloides gilesi	−	−	−	−	+	+
TOTALS 46	12	16	17	17	18	31
	26%	35%	37%	37%	39%	67%

METHODS.—Synonymies herein have been restricted to the works of Kemp (1913) and Holthuis (1941), where additional and older references may be found, and to one or two recent papers; synonymies are not intended to be complete.

All measurements are given in millimeters (mm). In the material examined, the numerals following the number of specimens is total length (TL) unless carapace length (CL) is specified. Total length is measured along the midline from the anterior margin of the rostral plate to the posterior apices of the submedian teeth of the telson;

carapace length, which does not include the rostral plate, is also measured on the midline.

The count of teeth on the dactylus of the raptorial claw always includes the terminal tooth. An abdominal spine formula of submedian 6, intermediate 4–6, lateral 2–6, marginal 1–5 indicates that the submedian carinae terminate in spines only on the sixth abdominal somite; the intermediate carinae terminate in spines on the

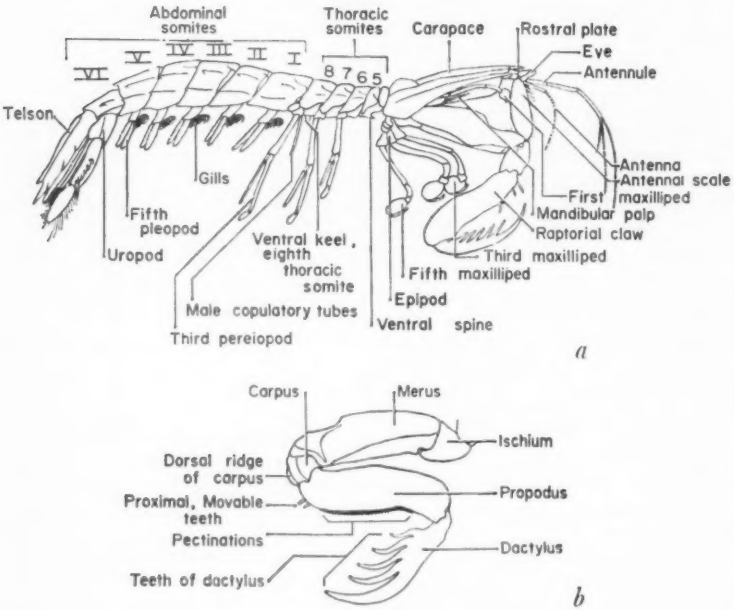

FIGURE 1.—Diagrammatic sketches: *a*, a squillid; *b*, a raptorial claw.

fourth, fifth, and sixth somites; the laterals are spined on the second to sixth somites, inclusive, and the marginals on the first to fifth somites, inclusive. A telson denticle formula of "4, 6–8, 1" indicates that on the margin of the telson, on either side of the midline, there are four submedian denticles, six to eight intermediate denticles, and one lateral denticle.

Many of the terms used in the descriptive accounts are shown in figures 1 and 2. Although the figures are based primarily on squillids,

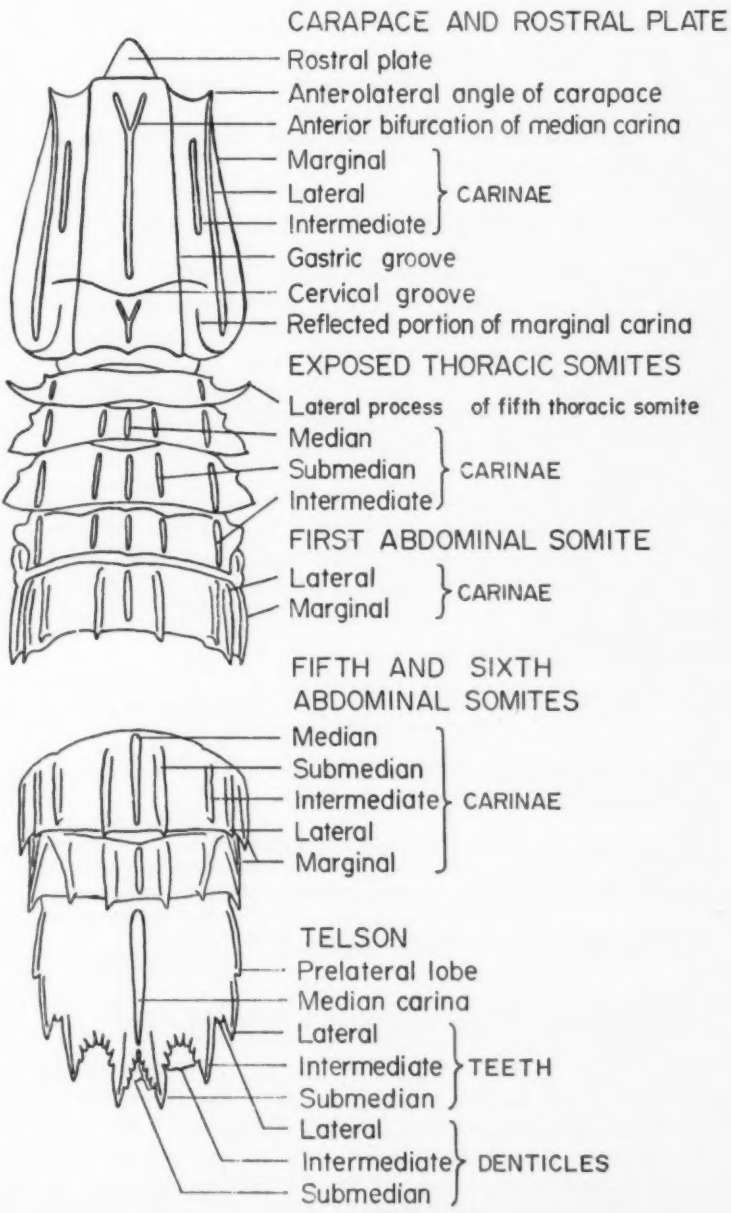

FIGURE 2.—Carinal terminology.

with the characteristic carination of the carapace, thorax, and abdomen, the general features of the carapace, claw, abdomen, telson, and uropod are similar in all of the stomatopods.

We have included sketches and a brief descriptive account of the male petasma (endopod of the first male pleopod) for all species represented by adult males.

Order STOMATOPODA Latreille, 1817

Until recently, this order was considered to include but one Recent family, Squillidae Latreille, 1803, with eight Recent genera. Studies on the classification of stomatopods by Serène (1962), Holthuis (1964), and Manning (1963, 1968a), have shown that the stomatopods comprise four families and 37 genera. The classification proposed by Manning (1968a) is used herein; that paper includes keys to all genera. For more detailed information on the order, the reader is referred to Balss (1938).

Representatives of three of the four families of stomatopods occur in the northwestern portions of the Indian Ocean; these three families may be distinguished by means of the key given below. The fourth family, Bathysquillidae, includes one deep-water genus, *Bathysquilla* Manning, with one Indo-West Pacific species known to occur off Japan and South Africa.

Key to Families of STOMATOPODA Occurring in the Northwestern Indian Ocean

1. Propodi of third and fourth thoracic appendages broader than long, beaded ventrally (fig. 3*d*); telson lacking sharp median carina.
   LYSIOSQUILLIDAE, p. 8.
   Propodi of third and fourth thoracic appendages longer than broad, not beaded ventrally (fig. 9*b*); telson with sharp median carina 2
2. No more than 2 intermediate marginal denticles present on telson.
   GONODACTYLIDAE, p. 14.
   More than 4 intermediate marginal denticles present on telson.
   SQUILLIDAE, p. 28.

Family LYSIOSQUILLIDAE Giesbrecht, 1910

DIAGNOSIS.—Propodi of third, fourth, and fifth thoracic appendages broader than long, beaded or ribbed ventrally (fig. 3*d*); telson lacking longitudinal median carina on dorsal surface (fig. 4*b*).

DISCUSSION.—Representatives of two of the genera currently assigned to this family occur off West Pakistan; they may be distinguished by means of the following key.

Key to Genera of Lysiosquillidae from West Pakistan

Dorsal surface of telson with fan-shaped row of 5 spines; rostral plate subquadrate (fig. 3*a*): uropodal endopod with strong proximal fold on outer margin. **Acanthosquilla**

Dorsal surface of telson unarmed; rostral plate cordiform (fig. 4*a*); uropodal endopod lacking strong proximal fold on outer margin . . . . . **Lysiosquilla**

Holthuis (1967a) has compiled synonymies for all known species in the family.

Acanthosquilla Manning, 1963

Diagnosis.—Cornea subglobular; rostral place subquadrate, trispinous anteriorly or with single apical spine; mesial and ventral antennal papillae present; mandibular palp present or absent; dorsal surface of telson with fan-shaped row of 5 spines; movable submedian marginal teeth present on telson; uropodal endopod with strong proximal fold on outer margin.

Type-species.—*Lysiosquilla multifasciata* Wood-Mason, 1895.

Remarks.—Manning (1968b) gave a key to the five Indo-West Pacific species of this genus. In addition to the single species *A. acanthocarpus* (Claus) recorded below from West Pakistan, three of the five Indo-West Pacific species are known from the western Indian Ocean and might occur off West Pakistan. *Acanthosquilla humesi* Manning is known only from Madagascar, but both *A. multifasciata* (Wood-Mason) and *A. vicina* (Nobili) were reported from the Red Sea by Ingle (1963).

1. *Acanthosquilla acanthocarpus* (Claus, 1871)

Figure 3

Lysiosquilla acanthocarpus.—Kemp, 1913, p. 120.—Chopra, 1934, p. 30.—Tiwari and Biswas, 1952, p. 359.—Barnard, 1962, p. 243.

Acanthosquilla acanthocarpus.—Holthuis, 1967a, p. 3 [references].—Manning, 1968b, p. 33 [key].—Chhapgar and Sane, 1968, p. 45 [key].

Material.—1 ♀, 52 mm; Manora Island, Karachi; 17 February 1965; Zoological Survey Reg. no. 1912.

Description.—Eye small, cornea globular, faintly bilobed, slightly wider than stalk (fig. 3*b*); antennal scale elongate; antennal protopod with 1 mesial and 1 ventral papilla; rostral plate (fig. 3*a*) as long as broad, subquadrate, with carinate median spine; lateral margins of rostral plate feebly sinuous and slightly convergent anteriorly, anterolateral angles truncate; carapace smooth, rounded anterolaterally and posterolaterally; cervical groove scarcely distinct even on lateral plates; dactylus of raptorial claw with 8 teeth (fig. 3*c*), penultimate smaller than either ultimate or antipenultimate; outer

margin of dactylus with 2 proximal lobes, distal slightly larger and more obtuse; upper margin of propodus with 4 large, movable, proximal spines and a row of 5 smaller spines extending distally;

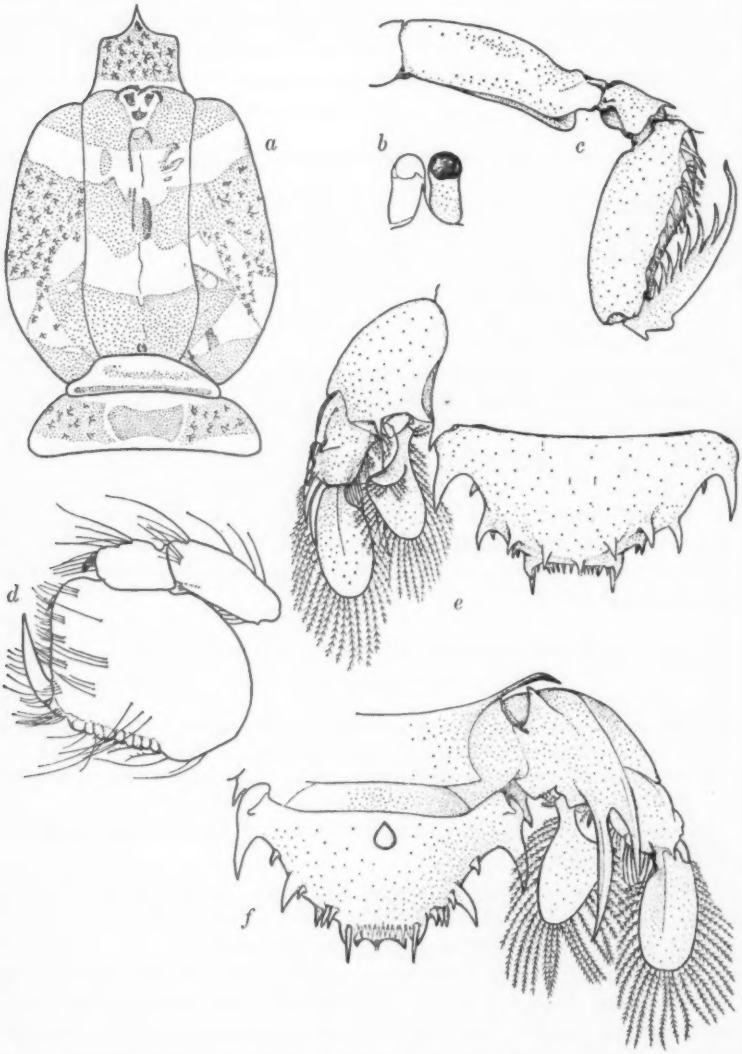

FIGURE 3.—*Acanthosquilla acanthocarpus* (Claus), female, TL 52 mm, Manora Island: *a*, outline of anterior portion of body to show color pattern; *b*, eyes; *c*, raptorial claw; *d*, fourth maxilliped; *e*, telson and uropod, dorsal view; *f*, same, ventral view.

dorsal ridge of carpus produced into a spine; mandibular palp 3-segmented; 5 epipods present; lateral processes of last 3 thoracic somites rounded anterolaterally and posterolaterally; abdomen elongate, depressed, loosely articulated, widest at fourth and fifth somites; posterolateral angles of sixth somite produced into sharp spines; sixth somite also with ventrally directed process on each side in front of articulation of uropods; telson (figs. 3*e*, *f*) almost twice as broad as long, with 4 pairs of fixed marginal teeth, submedians movable; 6 submedian denticles present on each side of midline, arranged in a transverse row, and 1 fixed denticle present between each of the marginal teeth; spines of dorsal surface extending to or slightly beyond margin; basal segment of uropod with dorsal spine; outer margin of proximal segment of exopod with 6 graded movable spines, last extending beyond midlength of distal segment; inner spine of basal prolongation of uropod longer and stouter.

COLOR.—Carapace with 3 more or less distinct bands of dark color (fig. 3*a*), posterolateral angles also dark; rostral plate uniformly dark except at base, speckled with darker chromatophores; fifth thoracic somite light; last 3 thoracic and first 5 abdominal somites each with broad, dark band in middle of segment, median portion of band on each somite darker than lateral portions; band on last abdominal somite lighter than on remainder of body; telson light; uropod with dark proximal patch, exopod with dark spot at articulation of distal segment, endopod dark beyond dorsal fold.

DISCUSSION.—*Acanthosquilla acanthocarpus* can be distinguished from *A. multifasciata* by several features. In the latter species, the two lobes on the dactylus of the claw are not subequal in size, but the distal is much larger than the proximal; the submedian denticles of the telson are not arranged in a transverse row, as in *A. acanthocarpus*, but in two curved rows; and there are but two pairs of marginal teeth on the telson, not four as in the present species.

Acanthosquilla vicina (Nobili), which has been recorded from the Red Sea, differs from both *A. acanthocarpus* and *A. multifasciata* in having 10–11 teeth on the dactylus of the claw, rather than 5 to 8, and in having sharp anterolateral angles on the rostral plate.

DISTRIBUTION.—Indo-West Pacific region, from the western Indian Ocean and Moçambique to Australia and Indo-Malaya. It has not been recorded previously from West Pakistan.

Lysiosquilla Dana, 1852

DIAGNOSIS.—Cornea bilobed; rostral plate cordiform, with apical spine; 1 mesial and 2 ventral antennal papillae present; mandibular palp present; dorsal surface of telson with at most a low median boss,

unarmed; telson usually lacking movable submedian teeth; uropodal endopod lacking strong proximal fold on outer margin.

TYPE-SPECIES.—*Lysiosquilla inornata* Dana, 1852.

REMARKS.—Four species of *Lysiosquilla* occur in the Indo-West Pacific region. One species, *L. capensis* Hansen, is known only from off South Africa; the other three have wider ranges. Only *L. tredecimdentata* Holthuis is known to occur off West Pakistan. The commonest species in the Indo-West Pacific region, *L. maculata* (Fabricius), could be expected off West Pakistan, but there are no authenticated records of that species from the northwestern Indian Ocean. Manning (1968b) gave a key to the Indo-West Pacific species.

2. *Lysiosquilla tredecimdentata* Holthuis, 1941

FIGURE 4

Lysiosquilla maculata.—Chopra, 1939, p. 161.—Holthuis, 1967a, p. 40.
Lysiosquilla maculata var. *tredecimdentata* Holthuis, 1941, p. 273, fig. 6.
Lysosquilla maculata.—Baig, 1954, p. 143 [erroneous spelling].
Lysiosquilla maculata tredecimdentata.—Manning, 1963, p. 317 [listed].
Lysiosquilla maculata maculata.—Ingle, 1963, p. 23 [part; not figs. 23, 45, 61, 72].
Lysiosquilla tredecimdentata.—Holthuis, 1967a, p. 23 [references].—Manning, 1968b, p. 38, fig. 13.

MATERIAL.—2 ♂, 120–259 mm; off Karachi; Central Fisheries Department, Karachi.

DESCRIPTION.—Eye large, cornea bilobed, set obliquely on stalk; ocular scales separate, broad, truncate dorsally; anterior margin of opthalmic somite produced into a median spine; anterior margin of basal segment of antenna with triangular projection (fig. 4*a*); antennal scale slender, 3 times as long as wide; rostral plate heart shaped, broader than long, with median carina on anterior half; carapace smooth, rounded anterolaterally and posterolaterally; raptorial claw large, dactylus with 11–12 teeth (13 in holotype); dorsal ridge of carpus of claw with deflexed spine; lateral process of fifth thoracic somite inconspicuous, lateral processes of next 2 somites flattened laterally, rounded anterolaterally, more truncate posterolaterally; ventral keel of eighth thoracic somite with acute posterior projection; abdominal somites unarmed, smooth, depressed, sixth somite with irregular surface laterally; telson much broader than long, with low, triangular, median boss, submedian bosses present but less distinct; lateral margin of telson pitted; posterolateral margin of telson with 4 pairs of fixed projections, innermost obtuse, outermost spiniform; submedian margin smooth, unarmed, indented along midline; uropodal exopod with 8 movable spines on outer margin of proximal segment; inner spine of basal prolongation of uropod much the longer.

COLOR.—Carapace with 3 dark bands, posteriormost narrowest and darkest; antennal scale outlined in black color; each body segment with a dark, transverse band; telson with an uninterrupted

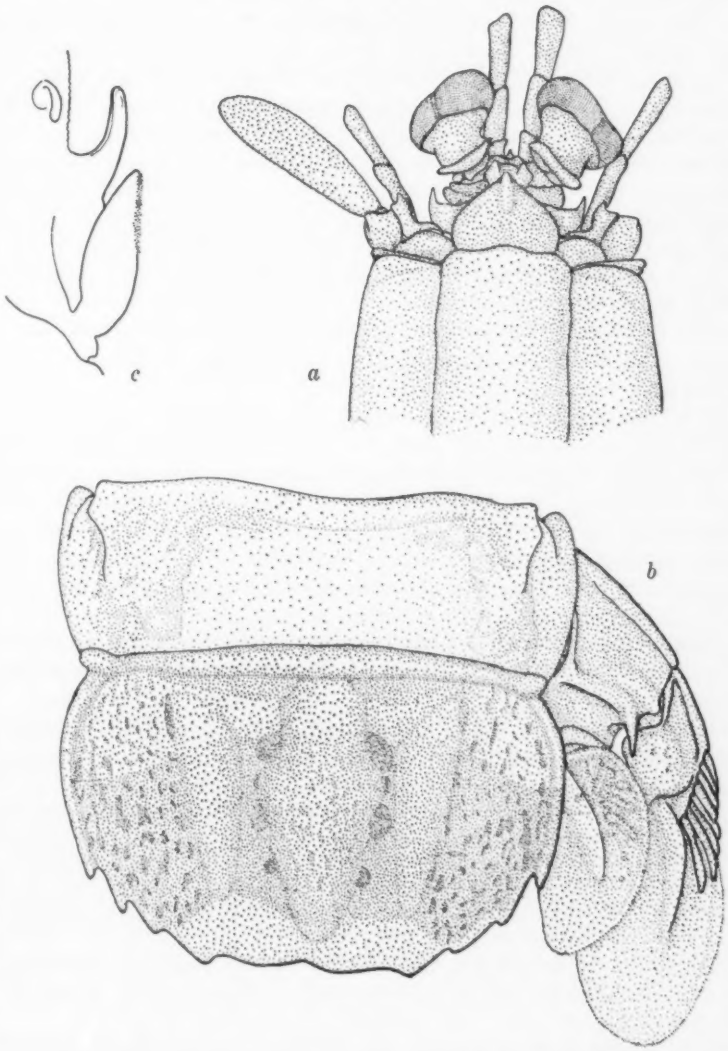

FIGURE 4.—*Lysiosquilla tredecimdentata* Holthuis, male, TL 120 mm, from off Karachi: *a*, anterior portion of body; *b*, last abdominal somite, telson, and uropod; *c*, petasma. (Setae omitted.)

transverse dark band, anterior margin and submedian portion of posterior margin lighter; uropodal exopod with dark spot at articulation of distal segment, apex of distal segment lighter; uropodal endopod dark.

DISCUSSION.—*Lysiosquilla tredecimdentata* is very similar in general appearance to *L. maculata* (Fabricius), a common Indo-West Pacific species, but Holthuis's species differs in several important respects as follows: (1) the ocular scales are broad and truncate dorsally; (2) the anterior margin of the antennal peduncle is produced into an acute projection (fig. 4*a*) whereas it is straight in *L. maculata;* (3) the antennal scale is slender and outlined in dark color rather than oval with a dark patch on the surface; (4) there are more teeth on the claw, 11–13 rather than 9–11; and (5) the ventral keel of the eighth thoracic somite is produced into a posterior spine and is not evenly rounded.

The petasma of the smaller male is shown in figure 4*c*. The hook process is extremely reduced; the tube process is slender, and retinaculae are confined to the distal half.

Manning (1968b) gave a detailed account of this species from Madagascar and suggested that the accounts of Chopra (1939) and Ingle (1963) based on a specimen from Aden identified as *L. maculata* might be referable to *L. tredecimdentata*. Since that manuscript was completed, one of us (R. B. M.) has had an opportunity of examining these authors' material at the British Museum. The single specimen from Aden, a female, TL 156 mm, clearly belongs to *L. tredecimdentata*.

The larger of the two specimens reported herein is probably the specimen on which Baig's record of *L. maculata* from Karachi was based.

DISTRIBUTION.—Western Indian Ocean, from Aden, West Pakistan, and Madagascar.

Family GONODACTYLIDAE Giesbrecht, 1910

DIAGNOSIS.—Propodi of third, fourth, and fifth thoracic appendages longer than broad, not beaded or ribbed ventrally (fig. 9*b*); telson with sharp median dorsal carina and no more than 2 intermediate denticles on margin.

REMARKS.—Three of the genera assigned to this family by Manning (1968a) occur off West Pakistan; they may be distinguished by use of the key given below.

Four species in other genera, reported from the Red Sea by Ingle (1963), could also be expected to occur off West Pakistan. These are: (1) *Pseudosquilla ciliata* (Fabricius), which has a wide distribution

in the Indo-West Pacific and Atlantic regions; (2) *P. megalophthalma* Bigelow, a rare Indo-West Pacific species; (3) *Eurysquilla sewelli* (Chopra), known only from the Red Sea; and (4) *Mesacturus brevisquamatus* (Paul'son), known to occur in the Red Sea and western Indian Ocean as well.

Key to Genera of GONODACTYLIDAE from West Pakistan

1. Dactylus of raptorial claw with 4 teeth; basal prolongation of uropod with spines on inner margin ..... **Manningia**
   Dactylus of raptorial claw unarmed; basal prolongation of uropod lacking spines on inner margin 2
2. Rostral plate sharply trispinous (fig. 6*a*); anterolateral angles of carapace not extending beyond base of rostral plate; sixth abdominal somite fused with telson ..... **Protosquilla**
   Rostral plate with median spine, anterolateral angles at most acute, not spiniform (fig. 7*a*); anterolateral angles of carapace extending beyond base rostral plate; sixth abdominal somite not fused with telson . **Gonodactylus**

Manningia Seréne, 1962

DIAGNOSIS.—Cornea bilobed, outer margin of eye longer than inner; rostral plate pentagonal; carapace unarmed, cervical groove indicated on lateral plates only; raptorial claw stout, dactylus with 4 teeth, propodus fully pectinate, carpus with 2 dorsal spines; fifth and sixth abdominal somites with carinae; telson with median carina and 5 pairs of lateral carinae on dorsal surface; submedian teeth of telson approximated, submedian denticles absent; 2 intermediate denticles present; intermediate and lateral denticles each flanked by sharp ventral denticle; basal prolongation of uropod terminating in 2 spines, with spinules on inner margin.

TYPE-SPECIES.—*Pseudosquilla pilaensis* de Man, 1888.

DISCUSSION.—Manning (1967a) reviewed the known species of *Manningia* and pointed out that the specimen reported from the Gulf of Aden by Nobili (1906) and others probably belonged to a new species. Because of the fragmented nature of the single specimen known from there, the species was not described. Since that study was completed, additional specimens from the Red Sea have been studied by L. B. Holthuis (1967b), who has described species as new. A single specimen of this species is reported herein from West Pakistan.

Manningia pilaensis (de Man), recently recorded from Bombay by Chhapgar and Sane (1968), could also occur off West Pakistan.

Two other species of *Manningia* have been recorded from localities in the Indo-West Pacific region, but neither of these are known to occur in the western Indian Ocean. Manning (1967a) provided a key to all of the species then known.

3. *Manningia amabilis* Holthuis, 1967

Manningia amabilis Holthuis, 1967b, p. 16, figs. 4–5.
Manningia species Manning, 1967a, p. 5, fig. 1 [other references].

MATERIAL.—1 ♂, 37 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, sand, scanty, scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW–1; IIOE; 27 November 1963; USNM.

DIAGNOSIS.—Rostral plate subpentagonal, rounded anterolaterally, lacking apical spine; ocular scales fused basally, apices separate; antennal protopod with 1 ventral papilla; dactylus of claw with 4 teeth; merus of claw lacking inferodistal spine on outer surface; sixth abdominal somite with 3 pairs of dorsal carinae, each armed posteriorly, low accessory carina present between submedians and intermediates; telson with median carina and 5 pairs of dorsal carinae, accessory medians subdivided into 2 tubercles, remainder entire; submedian and intermediate carinae each with blunt posterior lobe; basal prolongation of uropod with teeth on inner margin, lacking rounded lobe between distal spines.

COLOR.—Body completely covered with light brown chromatophores arranged in no particular pattern.

DISCUSSION.—This species of *Manningia* closely resembles *M. notialis* Manning from Australia but differs from it as follows: (1) the ocular scales are fused; (2) the rostral plate is more rounded anterolaterally; (3) there is a low ridge on the sixth abdominal somite lateral to each submedian carina; and (4) the accessory median carinae of the telson are divided into two blunt lobes, not three spined ones.

A more complete account of this species, including illustrations, has been published by L. B. Holthuis (1967b) in a paper on the stomatopods of the Red Sea that was issued after this paper was submitted for publication.

DISTRIBUTION.—Red Sea, Gulf of Aden, and Astola Island, West Pakistan; it has not been recorded previously from the latter locality.

Protosquilla Brooks, 1886

DIAGNOSIS.—Cornea subglobular or bilobed; rostral plate sharply trispinous; anterolateral margins of carapace not extending beyond base of rostral plate; mandibular palp present; sixth abdominal somite fused with telson; basal segment of uropodal exopod not extending beyond articulation of distal segment, marginal spines straight.

TYPE-SPECIES.—*Gonodactylus folini* A. Milne-Edwards, 1868.

REMARKS.—*Protosquilla* includes the species assigned by Kemp (1913) to *Gonodactylus* Group III. Three species of *Protosquilla*

have been recorded from the northwestern Indian Ocean, and two of these occur off West Pakistan. The third species, *P. spinosissima* (Pfeffer, 1888), has been recorded from the Red Sea by Ingle (1963) and could be expected to occur off Pakistan.

Key to *Protosquilla* from West Pakistan

Dorsal bosses of telson not extending posteriorly past midlength; posterior margin of telson with 4 pairs of teeth . . . . . **P. pulchella**
Dorsal bosses of telson extending almost to posterior margin; posterior margin of telson with 3 pairs of teeth . . . . . **P. lenzi**

4. *Protosquilla pulchella* (Miers, 1880)

FIGURE 5

Gonodactylus pulchellus.—Kemp, 1913, p. 177, pl. 10 (figs. 117–118).—Chopra, 1934, p. 41.—Holthuis, 1941, p. 288, fig. 9b [older references].—Ingle, 1963, p. 30, figs. 29, 49.
Gonodactylus pulchellurs.—Tirmizi, 1967, p. 35, fig. 2 [erroneous spelling].
Protosquilla pulchella.—Holthuis, 1967b, p. 42.—Manning, 1968b, p. 54.

MATERIAL.—2 ♀, 28–35 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, sand, scanty, scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW-1; IIOE; 27 November 1963; USNM.—1 ♂, 45 mm; off Karachi; University of Karachi; USNM.—4 ♂, 36–49 mm; 6 fragmented specimens; G. M. Hut, about 22 miles west of Karachi; Zoological Survey no. 1898.—1 broken ♂, CL 8.7 mm; 3 ♀ (2 broken), 45 mm; off Karachi; University of Karachi.

DESCRIPTION.—Anterior margin of ocular scales sinuous, scales produced laterally into acute lobes; eyes usually extending beyond end of basal segment of antennular peduncle; cornea subglobular; rostral plate sharply trispinous, median spine slenderer and longer than laterals; anterolateral margins of lateral plates of carapace concave, anterolateral angles acute but rounded; mandibular palp 2-segmented; dactylus of claw (fig. 5*c*) lacking basal notch on outer margin; first 4 abdominal somites almost smooth, at most marked by obscure lateral grooves; fifth abdominal somite with pits arranged in 2 rows on either side of ridge separating the smooth median portion from irregular lateral portions of somite; carinae of sixth abdominal somite and telson covered with short hairs; distal margin of telson (fig. 5*d*) divided into 2 halves by long, narrow, median fissure, distal margin of each half with 4 teeth or lobes, submedians with movable apices; several small submedian denticles present and 1 denticle present between each of remaining teeth; dorsal surface of telson with 3 bosses (fig. 5*d*) median triangular, external bosses on each side rounded or oval, not extending much past midlength of telson; surface of telson appearing pitted rather than coarsely reticulate; outer spine of basal prolongation of uropod (fig. 5*e*) much larger than inner.

COLOR.—Faded in most specimens; male has dark rectangular patches on the sixth thoracic and first and fourth abdominal somites, color most prominent on first abdominal somite; other specimens show traces of light banding over the body.

DISCUSSION.—The presence of short hairs on the dorsal surface of the last abdominal somite and telson, the smaller lateral dorsal bosses on the telson, and the four pairs of marginal teeth on the telson will immediately distinguish this species from *P. lenzi*.

The hook process of the petasma of *P. pulchella* is well developed and extends beyond the tube process. The latter is ornamented with a triangular projection, the margins armed with small blunt spines.

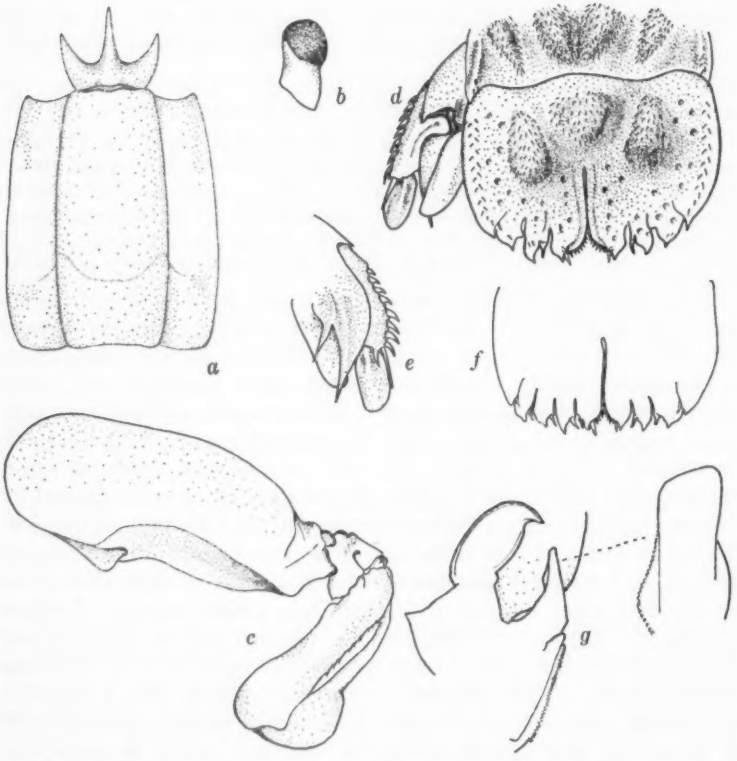

FIGURE 5.—*Protosquilla pulchella* (Miers), female, TL 45 mm, off Karachi: *a*, carapace and rostral plate; *b*, eye; *c*, raptorial claw; *d*, last abdominal somite, telson and uropod; *e*, uropod, ventral view. Female (broken), off Karachi: *f*, outline of telson. Male, TL 45 mm G. M. Hut: *g*, petasma.

One specimen, a female from off Karachi, has an abnormal telson, with five marginal teeth developed on the left side; it is shown in figure 5*f*.

DISTRIBUTION.—Indian Ocean, from the Red Sea and the coast of Africa to Australia. It was recorded previously from West Pakistan by Tirmizi (1967).

5. *Protosquilla lenzi* (Holthuis, 1941)

FIGURE 6

Gonodactylus glaber.—Kemp, 1913, p. 182, pl. 10 (fig. 121).
Gonodactylus lenzi Holthuis, 1941, p. 288 [older references].—Tiwari and Biswas, 1952, p. 362.—Ingle, 1963, p. 31, fig. 31.
Protosquilla lenzi.—Tirmizi, 1967, p. 32, fig. 1.—Holthuis, 1967b, pp. 36, 42.—Manning, 1968b, p. 54.

MATERIAL.—2 ♀, 27–42 mm; G. M. Hut, about 22 miles west of Karachi; 13 February 1965; University of Karachi.—3 ♂, 21–32 mm; 4 ♀, 24–35 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, sand, scanty, scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW-1; IIOE; 27 November 1963; USNM.

DESCRIPTION.—Anterior margin of ocular scales rounded, scales acute but rounded laterally; eyes extending beyond end of first segment of antennular peduncle; cornea subglobular; rostral plate

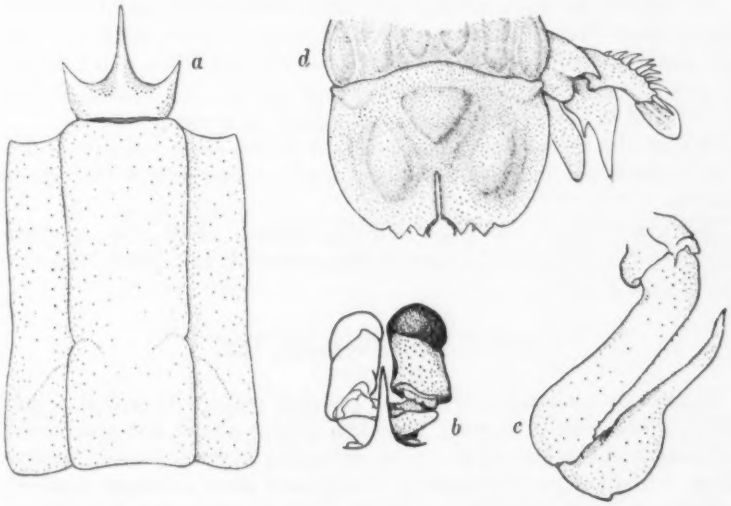

FIGURE 6.—*Protosquilla lenzi* (Holthuis), female, TL 42 mm, G. M. Hut: *a*, carapace and rostral plate; *b*, eyes; *c*, propodus and dactylus of raptorial claw; *d*, last abdominal somite, telson, and uropod.

sharply trispinous, median spine slenderer and longer than laterals; anterior margins of lateral plates of carapace concave, anterolateral angles rounded; mandibular palp 2-segmented; dactylus of claw with prominent notch on outer margin; first 4 abdominal somites smooth, with lateral groove flanked dorsally by slightly irregular area; fifth somite smooth dorsally, with 2 broad longitudinal swollen areas above lateral margin; carinae of sixth abdominal somite and telson smooth, not ornamented with setae; distal margin of telson (fig. 6*d*) divided into 2 halves by long, narrow, median fissure, distal margin of each half with 3 teeth or lobes, submedians with movable apices; several small submedian denticles present, at most 1 very small intermediate and lateral denticle present, either or both occasionally missing; dorsal surface of telson with 3 bosses, median rounded, smaller than more oval submedians, which extend posteriorly beyond midlength of telson (fig. 6*d*); outer spine of basal prolongation much broader and larger than inner.

COLOR.—Body marked with diffuse bands of dark chromatophores; sixth thoracic somite with median and lateral dark patches, seventh thoracic and first abdominal somites with dark median patch; telson with small dark spot at anterior end of each submedian boss.

DISCUSSION.—These specimens agree well with accounts of this species in the literature.

Protosquilla pulchella (Miers), the only other species of this genus known from West Pakistan, differs in having the dorsal surface of the sixth abdominal somite and telson covered with short hairs, in having smaller submedian bosses on the dorsal surface of the telson, and in having four pairs of marginal teeth on the telson.

One of the males from Astola Island differs from the remainder of the specimens in having but two teeth on one side of the telson margin.

DISTRIBUTION.—Indo-West Pacific region, from the western Indian Ocean to the Philippines. It was recorded from West Pakistan by Tirmizi (1967).

Gonodactylus Berthold, 1827

DIAGNOSIS.—Cornea subglobular; rostral plate with apical spine, anterolateral angles usually rounded, rarely acute, not spiniform; anterolateral margins of carapace extending beyond base of rostral plate; mandibular palp present; dactylus of claw unarmed, inflated basally; sixth abdominal somite free, not fused with telson; basal segment of uropodal exopod extending beyond articulation of distal segment, marginal spines straight.

TYPE-SPECIES.—*Gonodactylus chiragra* (Fabricius, 1781).

REMARKS.—This genus includes the species assigned by Kemp (1913) in his monograph of the Indo-West Pacific stomatopods to *Gonodactylus* Group I. Nine species have been reported from the northwestern Indian Ocean, and representatives of four of these are reported herein. The other five species, not now known to occur off West Pakistan, are: (1) *G. platysoma* Wood-Mason, 1895, a common species characterized by its broad body and by the presence of only two pairs of marginal teeth on the telson, the laterals being absent; (2) *G. falcatus* (Forskål, 1775), also a common species, which has five dorsal carinae in the center of the telson; (3) *G. choprai* Manning, a small, possibly rare species from moderate depths that lacks the fixed distal spine on the ventral surface of the proximal segment of the uropodal exopod; (4) *G. spinosus* Bigelow, a small species related to *G. lanchesteri* Manning and *G. demanii* Henderson (both reported below), which has a narrow telson tapering distally, with the intermediate teeth poorly developed, numerous small dorsal spinules on the telson, and a normal complement of setae on the uropod; and (5) *G. segregatus* Lanchester, a small species inhabiting moderate depths, which resembles *G. choprai* but has the distal ventral spine on the proximal segment of the uropod exopod. Any of these species could occur off West Pakistan if suitable habitats were available.

The four species of *Gonodactylus* now known from West Pakistan may be distinguished by means of the following key.

Key to *Gonodactylus* from West Pakistan

1. Dorsal surface of telson lacking spinules 2
   Dorsal surface of telson with spinules 3
2. Anterolateral angles of rostral plate rounded; carinae of telson inflated, marginal teeth blunt . . . . . **G. chiragra**
   Anterolateral angles of rostral plate acute; carinae of telson slender, usually with apical spinule, marginal teeth sharp . . . . . **G. smithii**
3. Uropodal endopod completely fringed with setae . . . . . **G. lanchesteri**
   Most of inner margin of uropodal endopod smooth, nonsetose, 10 or less proximal setae present . . . . . **G. demanii**

6. *Gonodactylus chiragra* (Fabricius, 1781)

FIGURE 7

Gonodactylus chiragra.—Kemp, 1913, p. 155, fig. 2 on p. 161, pl. 9 (fig. 107).—Holthuis, 1941, p. 277, fig. 7 [older references].—Barnard, 1950, p. 861.—Baig, 1954, p. 143.—Manning, 1966, p. 113.—Holthuis, 1967b, pp. 25, 41.—Manning, 1968b, p. 43.—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—2 ♂, 1 soft, other 68 mm; 4 ♀, 43–78 mm; off Karachi; University of Karachi.—1 ♀, 74 mm; Hyderabad; University of Karachi.—1 ♀, 52 mm; Manora Island, Karachi; S. M. H. Balgrammi; 10 October 1953; Zoological Survey reg. no. 272.—1 ♂, 71 mm; 1 ♀, 69 mm; same; N. Tirmizi, R. B. Manning,

et al.; 9 March 1967; University of Karachi.—1♂, 77 mm; off Karachi; Mohammed Abdullah el Husseini; USNM.—1♂, 53 mm; 1♀, 52 mm; off Karachi; USNM.—1♀, 73 mm; Pasni, Makran coast; F. Townsend; BMNH reg. no. 1898.5.23.2.—6♂, 24–66 mm; 7♀, 38–53 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, scanty, scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW–1; IIOE; 27 November 1963; USNM.—2♀, 50–56 mm; same data; Sta. RF–2; IIOE; USNM.

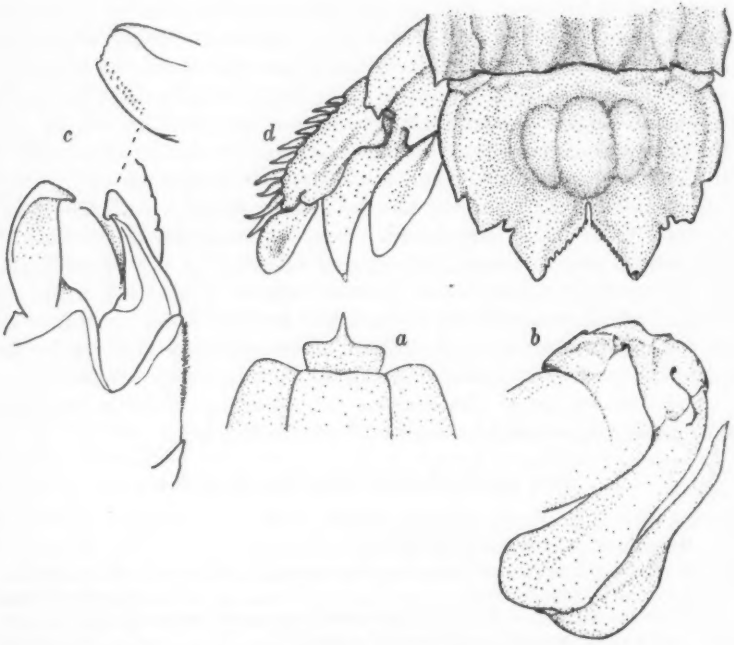

FIGURE 7.—*Gonodactylus chiragra* (Fabricius), male, TL 68 mm, off Karachi: *a*, anterior portion of carapace and rostral plate; *b*, carpus, propodus, and dactylus of raptorial claw; *d*, last abdominal somite, telson, and uropod (setae omitted). Male, TL 71 mm, Manora Island: *c*, petasma.

DIAGNOSIS.—Anterolateral angles of rostral plate rounded (fig. 7*a*), anterior margins straight or with slight anterior slope; ocular scales large, truncate; telson broader than long, dorsal surface unarmed, dorsal carinae each with at most an apical tubercle; accessory median carinae short, forming anchor; 3 pairs of marginal teeth present, submedians with movable apices, intermediates broad, blunt, laterals poorly formed but distinct; carinae of marginal teeth broad, inflated; numerous small submedian denticles and 2 intermediate denticles

present, intermediates recessed anteriorly; uropod with full complement of setae.

COLOR.—Faded in most specimens; in two fresh specimens from Manora Island the male was dark brownish green, the female a lighter green; on both specimens the display patches on the dorsal surface of the merus of the chelae were whitish, lined with light green, with 2 distal spots.

DISCUSSION.—*Gonodactylus chiragra* is the most common species of the genus in the Indo-West Pacific region, and it can be recognized without difficulty through the characters outlined above. *Gonodactylus smithii* Pocock, discussed below, differs in having acute anterolateral angles on the rostral plate and in other features as well. The display patch on the merus of the claw in *G. smithii* is blue or crimson in life, not whitish as in *G. chiragra*.

On the male petasma, the hook process is swollen in the middle and extends as far as or a little beyond the tube process; the latter has a truncated distal margin, armed with small distolateral spines (fig. 7*c*).

In the largest male examined (CL 18.1 mm) the median carina is so swollen that it completely obliterates the accessory medians with the result that no anchor is visible (fig. 7*d*). In general, the carinae of the telson in males are more swollen than in females.

The rostral plate figured by Ingle (1963) for a specimen of *G. chiragra* is the typical shape of the rostral plate of *G. smithii*.

The two specimens collected by us at Manora Island were found burrowing in a rocky flat exposed at low tide.

DISTRIBUTION.—Throughout the Indo-West Pacific region, from the Red Sea and East Africa to Japan, with the exception of Hawaii.

7. *Gonodactylus smithii* Pocock, 1893

FIGURE 8

Gonodactylus smithii Pocock, 1893, p. 475, pl. 20B (fig. 1).—Manning, 1966, p. 112.—Holthuis, 1967b, pp. 28, 41.—Manning, 1968b, p. 44 [references].
Gonodactylus chiragra chiragra.—Ingle, 1963, p. 27, figs. 27, 47, 63.

MATERIAL.—1 ♀, 74 mm; off Karachi; University of Karachi.—1 ♂, 29 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, sand, scanty, scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW–1; IIOE; 27 November 1963; USNM.

DIAGNOSIS.—Anterolateral angles of rostral plate acute, sharp, anterior margins sloping anteriorly; ocular scales large, truncate; sixth abdominal somite with 6 sharp carinae, most ending in spines; telson broader than long, dorsal surface unarmed, dorsal carinae each usually with an apical tubercle; dorsal carinae slender, accessory medians present, fusing with median to form anchor; 3 pairs of marginal teeth present, submedians with movable apices, interme-

diates sharp, laterals poorly formed but distinct; carinae of marginal teeth sharp; numerous small submedian and 2 sharp intermediate denticles present, intermediates recessed anteriorly.

COLOR.—Fresh specimens and most specimens in preservative show traces of a crimson or blue display patch on the dorsal surface of the merus of the claw; the dactylus of the claw is pink.

DISCUSSION.—The sharp anterolateral angles of the rostral plate will immediately distinguish this species from *G. chiragra* as well as most other Indo-West Pacific species of the genus. The only other

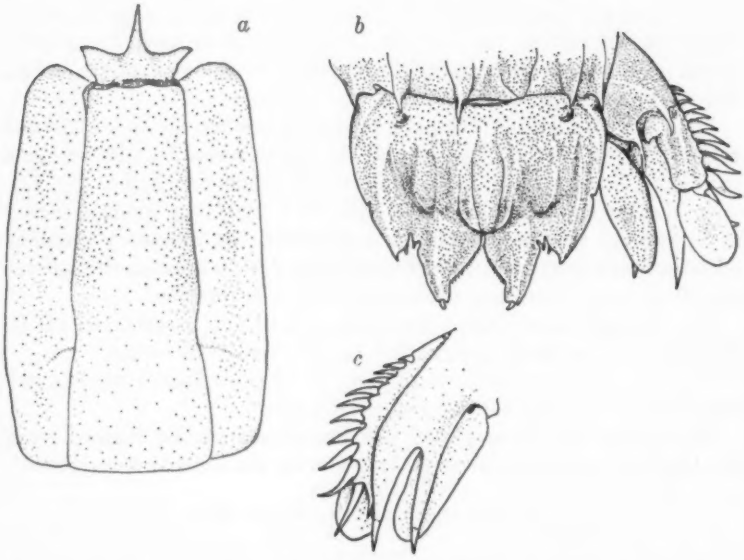

FIGURE 8.—*Gonodactylus smithii* Pocock, female, TL 74 mm, off Karachi: *a*, carapace and rostral plate; *b*, last abdominal somite, telson, and uropod; *c*, uropod, ventral view. (Setae omitted.)

species from the Indo-West Pacific region with a similar rostral plate is *G. hendersoni* Manning (see Manning, 1967b), which differs in numerous features, including the presence of dorsal spinules on the telson.

In his account of this species from Madagascar, Manning (1968b) noted that *G. smithii* and *G. acutirostris* de Man were probably conspecific. Manning also placed Ingle's (1963) record of *G. chiragra chiragra* from the Red Sea in the synonymy of *G. smithii;* the rostral plate of *G. chiragra* illustrated by Ingle is almost certainly that of *G. smithii.*

The small specimen of this species from Astola Island has a faintly sinuate inner margin on the uropodal endopod, as in the specimens from Madagascar reported by Manning (1968b).

DISTRIBUTION.—Indo-West Pacific, from Vietnam, Australia, and the western Indian Ocean. It has not been recorded previously from West Pakistan.

8. *Gonodactylus lanchesteri* Manning, 1967

FIGURE 9

Gonodactylus spinosus.—Holthuis, 1967b, pp. 34, 42.

Gonodactylus lanchesteri Manning, 1967b, p. 11, fig. 4 [other references]; 1968b, p. 51.

MATERIAL.—1 ♂, 30 mm; 1 ♀, 24 mm (in 2 lots); off Karachi; University of Karachi.

DIAGNOSIS.—Anterolateral angles of rostral plate rounded or subacute, anterior margins straight, ocular scales small, erect; carinae of sixth abdominal somite swollen, each usually with apical tubercle; telson broader than long, dorsal surface ornamented with numerous small spinules and tubercles; all carinae of dorsal surface inflated; anterior dorsal carinae smooth dorsally, spinulose laterally; carinae of marginal teeth very spinulose dorsally; 3 pairs of marginal teeth present, submedians with movable apices; submedian and intermediate teeth blunt, broad, lateral teeth sharper; numerous small submedian and 2 sharp intermediate denticles present, inner larger and set at level of apex of intermediate tooth, outer more recessed anteriorly; submedian teeth lacking well-marked ventral carinae; uropod with full complement of setae; outer spine of basal prolongation of uropod broader and slightly longer than inner.

COLOR.—Almost completely faded; there are traces of black spots in no particular pattern on the dorsum of the male.

DISCUSSION.—Manning (1967b) noted that specimens of this species showed two different patterns of dorsal spinulation on the telson. The specimens reported herein are of the form with numerous small spinules approaching the condition found in *G. spinosus* Bigelow. The well-developed intermediate teeth of the telson will immediately distinguish this species from *G. spinosus*, to which it is closely related.

The full complement of setae on the uropod will distinguish this species from *G. demanii* (discussed below), in which most of the inner margin of the uropodal endopod and exopod is smooth and devoid of setae.

The larger male specimen differs from the female in having all of the carinae of the telson more inflated and in having fewer, blunter

tubercles on the dorsal surface of the telson. In the male the median carina is almost subglobular. It also differs from the female in having the outer intermediate denticle set slightly posterior to the apex of the intermediate tooth.

The petasma in the male is similar to that of *G. chiragra*.

DISTRIBUTION.—Western Indian Ocean, where it has been recorded from numerous localities. It has not been recorded previously from West Pakistan.

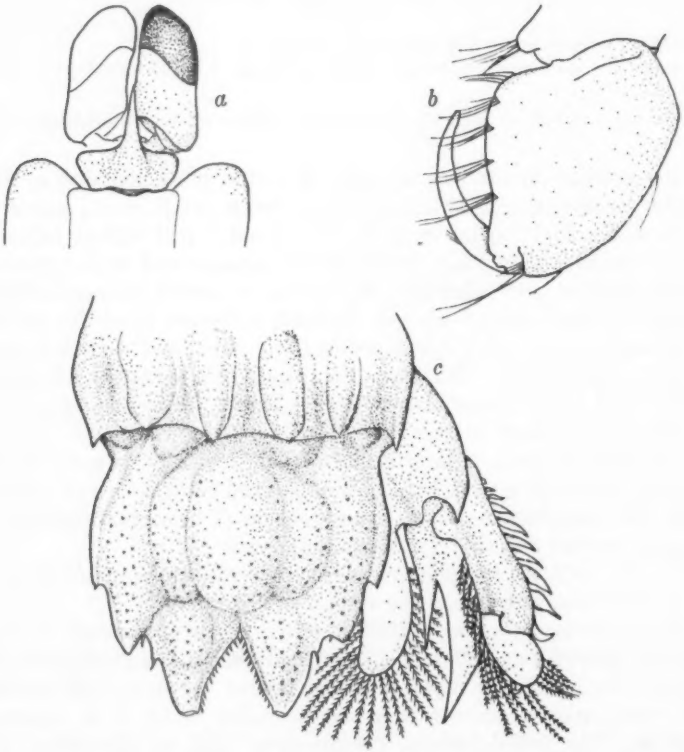

FIGURE 9.—*Gonodactylus lanchesteri* Manning, female, TL 24 mm, off Karachi: *a*, anterior portion of carapace, rostral plate, and eyes; *b*, propodus of fourth maxilliped; *c*, last abdominal somite, telson, and uropod.

9. *Gonodactylus demanii* Henderson, 1893

FIGURE 10

Gonodactylus demanii.—Manning, 1967b, p. 8, fig. 3 [older references].—Holthuis, 1967b, pp. 32, 41.—Manning, 1968b, p. 50.

Gonodactylus demani demani.—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—1 ♀, 22 mm; western end of Astola Island, ca. 177 miles west of Karachi; rocks, sand, scanty scattered coral; 0–8 ft; L. P. Woods, et al.; Sta. LW-1; IIOE; 27 November 1963; USNM 120473.

DIAGNOSIS.—Anterolateral angles of rostral plate subacute, usually rounded; ocular scales small, erect; carinae of sixth abdominal somite swollen, each usually with apical tubercle; telson broader than long, dorsal surface ornamented with numberous spinules and small tubercles; anterior dorsal carinae smooth dorsally, spinulose laterally;

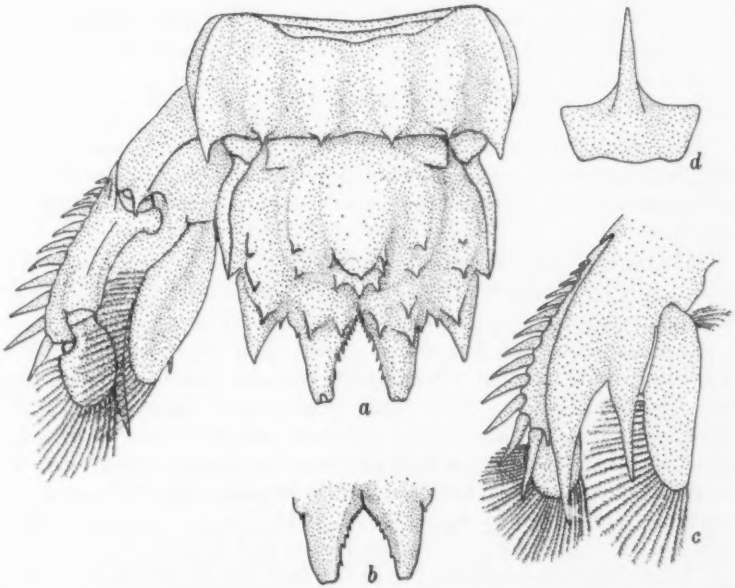

FIGURE 10.—*Gonodactylus demanii* Henderson, female, TL 19 mm, Dahlak, Red Sea: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, uropod, ventral view; *d*, rostral plate. (From Manning, 1967b.)

carinae of marginal teeth spinulose dorsally; 3 pairs of marginal teeth present, submedians with movable apices; submedian and intermediate teeth sharper than laterals; numerous small submedian and 2 sharp intermediate denticles present, intermediates both recessed anteriorly; submedian teeth each with low carina on inner ventral surface; endopod slender; most of inner margin of both endopod and exopod of uropod smooth, devoid of setae, endopod with 9–10 small, proximal setae; outer spine of basal prolongation of uropod broader and longer than inner.

COLOR.—Largely faded in the present specimen; there are scattered dark spots on the sixth thoracic and first, third, and fourth abdominal somites, and an anterior pair of dark spots on the telson.

DISCUSSION.—The smooth inner margin on the uropodal endopod and exopod will serve to distinguish this species from the other species of the genus occurring off West Pakistan.

The illustrations that we give herein have been taken from Manning (1967b) because the condition of our single specimen from Astola Island is not good enough to be illustrated.

DISTRIBUTION.—Western Indian Ocean. It has been recorded from Karachi (Kemp, 1913) and from Astola Island (Manning, 1967b).

Family SQUILLIDAE Latreille, 1803

DIAGNOSIS.—Propodi of third, fourth, and fifth thoracic appendages longer than broad, not beaded or ribbed ventrally (fig. 15*c*); telson with sharp median dorsal carina and 4 or more intermediate denticles on margin.

DISCUSSION.—Representatives of four of the genera assigned to this family by Manning (1968a) occur off West Pakistan. These genera can be distinguished by means of the key given below.

Representatives of five other genera may also occur off West Pakistan; these include: *Carinosquilla carinata* (Serène), known from the Red Sea (Ingle, 1963) and Madagascar (Manning, 1968b); *Squilloides gilesi* (Kemp), which has been reported from the Persian Gulf by Kemp (1913), the Gulf of Oman by Chopra (1939), and the Red Sea by Holthuis (1967b); *Alima supplex* (Wood-Mason), reported from Bombay by Kemp (1913) and Chhapgar and Sane (1968); and both *Anchisquilla fasciata* (de Haan) and *Leptosquilla schmeltzii* (A. Milne-Edwards), recorded from the Red Sea by Holthuis (1967b).

Key to Genera of SQUILLIDAE from Pakistan

1. Cornea small, usually not as broad as stalk; ocular scales fused; submedian teeth of telson with movable apices . . . . . **Clorida**
   Cornea small or large, always broader than stalk; ocular scales separate; submedian teeth of telson with fixed apices 2
2. Carapace with deep posterolateral excavation; propodus of raptorial claw with row of erect spines . . . . . **Harpiosquilla**
   Carapace rounded posterolaterally; propodus of raptorial claw with pectinations but not erect spines 3
3. Lateral processes of fifth, sixth, and seventh thoracic somite single, not bilobed; less than 4 epipods present . . . . . **Cloridopsis**
   Lateral processes of fifth, sixth, and seventh thoracic somites bilobed; 4 or more epipods present . . . . . **Oratosquilla**

Clorida Eydoux and Souleyet, 1842

DIAGNOSIS.—Eye small, cornea bilobed, rarely broader than dilated stalk; ocular scales fused along midline; carapace rounded posterolaterally; mandibular palp usually present; 2–4 epipods present; dactylus of raptorial claw with 4–5 teeth, upper margin of propodus pectinate; lateral processes of fifth, sixth, and seventh thoracic somites not bilobed, process of fifth somite usually a slender spine; abdomen broad, depressed, carinae usually reduced in number; telson with movable apices on submedian teeth; basal prolongation of uropod with spines on inner margin.

TYPE-SPECIES.—*Clorida latreillei* Eydoux and Souleyet, 1842.

DISCUSSION.—Five species of *Clorida* are known to occur in the northwestern Indian Ocean and one of these is reported herein from West Pakistan. *Clorida fallax* (Bouvier) has been reported from the Red Sea by Holthuis (1967a) and *C. latreillei* has been recorded from the Persian Gulf by Kemp (1913). More recently, Chhapgar and Sane (1967) described two new species from Bombay, *C. denticauda* and *C. bombayensis*. Any of these species could occur off West Pakistan.

Manning (1968b) gave a key to all the species of *Clorida*.

10. *Clorida microphthalma* (H. Milne-Edwards, 1837)

FIGURE 11

Squilla microphthalma.—Kemp, 1913, p. 31, pl. 1 (figs. 17–20.— Holthuis, 1941, p. 242.—Tiwari and Biswas, 1952, p. 350.—Manning, 1968b, p. 5 [key].—Chhapgar and Sane, 1968, p. 44 [key].

Material.—1 ♀, 32 mm; off Karachi; University of Karachi.

DESCRIPTION.—Eye small, cornea bilobed, set obliquely on stalk; stalk expanded proximally, expanded portion broader than cornea (fig. 11*b*); eyes appressed for most of their length, extending about to end of first segment of antennular peduncle; ocular scales subtruncate; rostral plate triangular, as long as broad, apex rounded; carapace strongly narrowed anteriorly, without carinae except for reflected marginals; anterolateral spines of carapace strong but not extending past base of rostral plate (fig. 11*a*); dactylus of claw with 5 teeth, outer margin sinuous; dorsal ridge of carpus undivided, terminating in blunt angle (fig. 11*c*); mandibular palp present; 4 epipods present; thoracic somites lacking submedian carinae; low, unarmed intermediate carinae present on last 3 somites; lateral process of fifth thoracic somite an angular lobe, directed anterolaterally; fifth somite also with 1 pair of ventrolateral tubercles; lateral processes of sixth and seventh thoracic somites rounded anterolaterally and posterolaterally; abdomen smooth, depressed,

lacking submedian carinae on first 5 somites; abdominal carinae spined as follows: submedian 6, intermediate 5–6, lateral 5–6, marginal 4–5; telson broad, inflated, with 3 pairs of marginal teeth, submedians with movable apices, intermediates and laterals sharp; prelateral lobes not developed; dorsal surface of telson with median carina, a submedian row of tubercles coverging under its distal apex, and several curved rows of tubercles or denticles on the lateral surface; marginal denticles spiniform, 1–2, 7–8, 1; postanal keel absent; uropodal exopod with 5–6 movable spines on outer margin of proximal

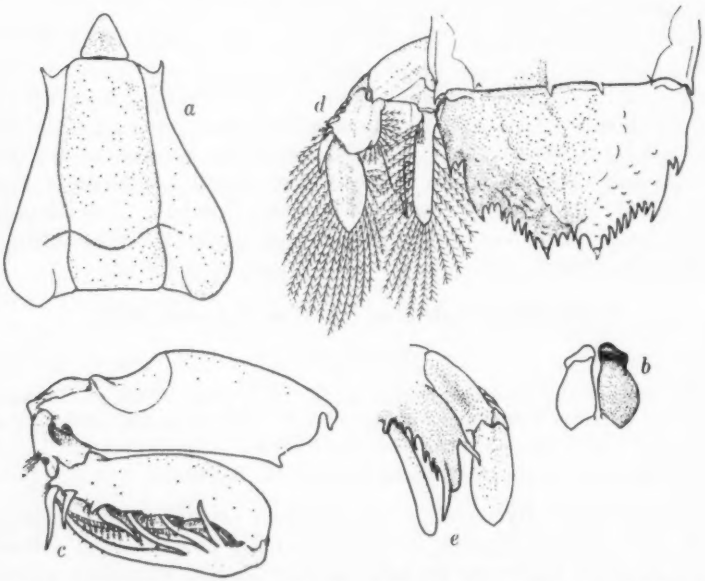

FIGURE 11.—*Clorida microphthalma* (H. Milne-Edwards), female, TL 32 mm, off Karachi: *a*, outline of carapace and rostral plate; *b*, eyes; *c*, raptorial claw; *d*, telson and uropod; *e*, uropod, ventral view (setae omitted).

segment; basal prolongation of uropod with 5–6 fixed spines on inner margin and broad, rounded lobe on outer margin of inner spine (fig. 11*e*).

COLOR.—Largely faded in the present specimen, but carapace, last 3 thoracic and first 5 abdominal somites each with posterior black line; anterolateral plates of abdomen darker than body; proximal segment of uropodal exopod dark distally.

DISCUSSION.—Among the characteristic features of *C. microphthalma* are the elongate eyes, with a very small cornea, the small lateral processes on the fifth thoracic somite, the lack of submedian carinae

on the last three and first five thoracic somites, and the small number of spines on the abdominal carinae.

DISTRIBUTION.—Indo-West Pacific, from East Africa to China and Australia. Kemp (1913) listed two specimens from Karachi.

Harpiosquilla Holthuis, 1964

DIAGNOSIS.—Eye large, T-shaped, cornea bilobed, distinctly broader than stalk (fig. 13*a*); ocular scales separate; carapace with deep posterolateral excavations; mandibular palp 3-segmented; 5 epipods present; dactylus of raptorial claw with teeth, upper margin of propodus with row of large, erect spines and intervening smaller spines or denticles (fig. 12*e*); lateral processes of next 2 somites not strongly bilobed, sinuous, sharp posterolaterally; abdomen broad, submedian carinae usually present; telson with apices of submedian teeth fixed; basal prolongation of uropod with at most tubercles on inner margin.

TYPE-SPECIES.—*Squilla harpax* de Haan, 1844.

DISCUSSION.—This genus now includes four species, all of which occur in the western Indian Ocean. Two of the species, *H. harpax* (de Haan) and *H. raphidea* (Fabricius), occur off West Pakistan. A third species, *H. annandalei* (Kemp), has been recorded from the Gulf of Oman by Chopra (1939), and the fourth species, *H. melanoura* Manning, is known only from Madagascar.

We have included here an account of a single specimen of *H. raphidea* from East Pakistan from the collection of the Zoological Survey Department.

The two species known from Pakistan may be distinguished by means of the following key.

Key to Species of *Harpiosquilla* from West Pakistan

Lateral process of fifth thoracic somite spined; propodus of claw with alternate long and short spines. . . . . **.H. raphidea**

Lateral process of fifth thoracic somite rounded; propodus of claw with more than 1 short spine between longer ones. . . . . **.H. harpax**

11. *Harpiosquilla raphidea* (Fabricius, 1798)

FIGURE 12

Squilla raphidea.—Kemp, 1913, p. 88, pl. 7 (fig. 77) [part; older references].—Tiwari and Biswas, 1952, p. 356, figs. 3a, c, e.

Harpiosquilla raphidea.—Manning, 1968b, p. 14 [key].—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—1 ♀, 261 mm: Cox's Bazaar, Chittagong, East Pakistan: Zoological Survey reg. no. 888.—1 ♀, 189 mm; Fish Harbour, Karachi; 17 April 1967; University of Karachi.

DIAGNOSIS.—Size large to very large, TL 300 mm or more; rostral plate triangular, apex blunt; carinae of carapace well developed; dactylus of raptorial claw with 8 teeth; upper margin of propodus of claw with widely separated alternate long and short spines; lateral process of fifth thoracic somite produced into an acute spine, ventral process on each side acute; last 3 thoracic somite with well-formed

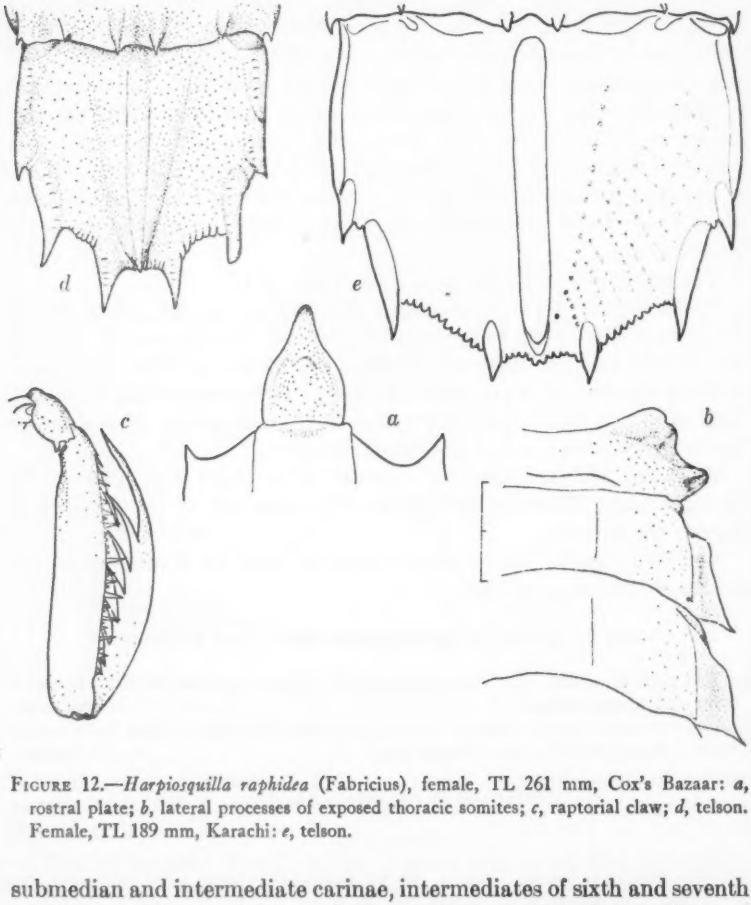

FIGURE 12.—*Harpiosquilla raphidea* (Fabricius), female, TL 261 mm, Cox's Bazaar: *a*, rostral plate; *b*, lateral processes of exposed thoracic somites; *c*, raptorial claw; *d*, telson. Female, TL 189 mm, Karachi: *e*, telson.

submedian and intermediate carinae, intermediates of sixth and seventh somites armed posteriorly on large specimens; submedian carinae of abdomen well developed; abdominal carinae spined as follows: submedian 6, intermediate 1–6, lateral 1–6, marginal 1–5; telson with broad median carina and 3 pairs of marginal teeth; prelaterals lobes absent; denticles rounded, 5–6, 7, 1; outer margin of basal

segment of uropodal exopod with 8 spines, last short; lobe on outer margin of inner spine of basal prolongation rounded, margin concave.

COLOR.—Faded in the specimen from East Pakistan. The specimen from Karachi was examined while fresh; one of us (N.T.) made the following color notes: ocular peduncles light pink; posterior border of carapace with a black band; antennal scale yellowish, outlined with dark pigment; claw with merus pink, also marked with a greenish-yellow patch; distal end of propodus with bright yellow streak; thorax and abdomen appearing speckled; last 3 thoracic and first 3 abdominal somites pink, last 3 abdominal somites more cream-colored; tips of spines of last 4 abdominal somites yellow; posterior margin of first 4 abdominal somites black; carinae of telson bluish, apices of teeth yellow; telson with pair of submedian yellow-brown spots; uropod lightly marked with yellow and black, inner half of distal segment of exopod grayish, outer half yellow.

DISCUSSION.—The large size of this species and the acutely pointed lateral process of the fifth thoracic somite will immediately distinguish it from *H. harpax*. Other differences have been noted under the account of the latter species.

DISTRIBUTION.—Indian Ocean, from East Africa to Australia. Kemp (1913) recorded it from Karachi.

12. *Harpiosquilla harpax* (de Haan, 1844)

FIGURE 13

Squilla raphidea.—Kemp, 1913, p. 88 [part].—Chopra, 1939, p. 158.—Barnard, 1950, p. 851, figs. 1c, g.

Squilla harpax.—Tiwari and Biswas, 1952, p. 358, figs. 3b, d, f.—Ingle, 1963, p. 18, figs. 9, 59.

Harpiosquilla harpax.—Holthuis, 1967b, pp. 14, 40.—Manning, 1968b, p. 15, fig. 4.—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—1 ♂, 107 mm; Ahsan; University of Karachi.—1 ♀, 142 mm; off Karachi; Central Fisheries Department.—1 dry ♀, CL 35.6 mm; near Karachi; Mohammed Abdullah el Husseini; USNM.

DIAGNOSIS.—Size moderate to large, TL 200 mm or less; rostral plate acutely pointed, lateral margins sinuous (fig. 13*a*); dactylus of raptorial claw with 8 teeth; upper margin of propodus of claw with series of long, erect spines, with 1 or more shorter spine or spinule between the long ones (fig. 13*c*); lateral process of fifth thoracic somite rounded (fig. 13*b*), ventral process on each side acute; last 3 thoracic somites with submedian and unarmed intermediate carinae, submedians low; submedian carinae of abdomen poorly developed but present; abdominal carinae armed as follows: submedian 6, intermediate 1–6, lateral 1–6, marginal 1–5; telson with sharp median carina and 3 pairs of sharp marginal teeth, prelateral lobes

absent; denticles spiniform, 5, 13, 1; outer margin of basal segment of uropodal exopod with 9–10 spines, last short; lobe on outer margin of inner spine of basal prolongation rounded, margin concave.

COLOR.—Fresh specimens are brightly colored, as follows: eyestalks bright yellow; antennal peduncle and scale with pink patches; carinae of carapace lined with dark spots; merus and carpus of rap-

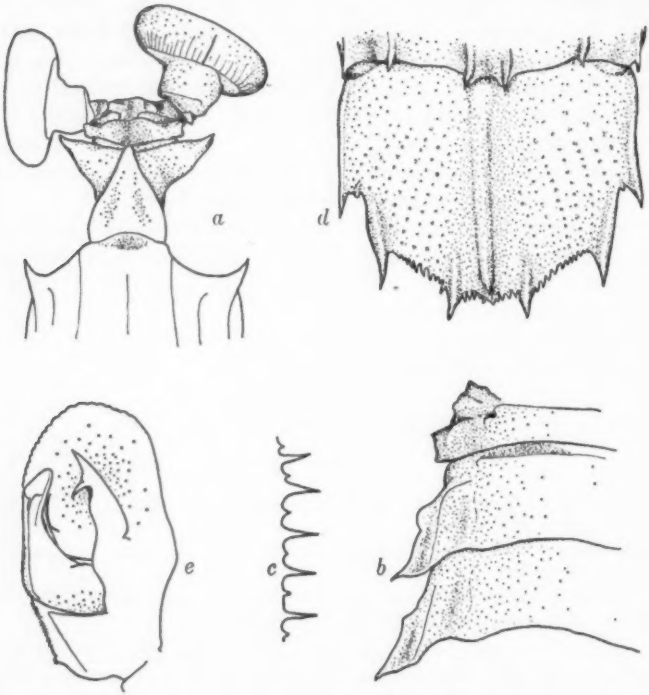

FIGURE 13.—*Harpiosquilla harpax* (de Haan), male, TL 107 mm, Ahsan: *a*, anterior portion of carapace, rostral plate, and eyes; *b*, lateral processes of exposed thoracic somites; *c*, spines on upper margin of propodus of claw; *d*, telson; *e*, petasma.

torial claw with pink patches; posterior margin of each of thoracic and abdominal somites lined with black spots; lateral portions of abdominal somites pink; sixth abdominal somite pink between submedian carinae; spines on abdomen, telson, and uropod yellow; telson with grey pits and carinae except for red median carina; proximal submedian patches of telson maroon (black in preservative); base of uropod pink.

DISCUSSION.—Tiwari and Biswas (1952) were the first to show that *H. harpax* (de Haan) is distinct from the larger *H. raphidea* (Fabricius), which is also widely distributed in the Indo-West Pacific region. *Harpiosquilla harpax* differs from *H. raphidea* in having a shorter rostral plate, in lacking the lateral spine on the fifth thoracic somite, in having more than one spine or spinule between the major spines on the propodus of the claw, and in having the carinae of the abdomen less well developed. In *H. harpax* the submedian carinae of the abdomen are present but they are poorly-defined.

The petasma is illustrated in figure 13*e*. The tube process is well developed; the hook process has an additional hook-like projection on its inner, distal margin.

DISTRIBUTION.—Indo-West Pacific region, from the Red Sea and South Africa eastward to Japan.

Cloridopsis Manning, 1968

DIAGNOSIS.—Eye small, stalk dilated or margins subparallel, cornea broader than stalk; ocular scales separate; carapace rounded posterolaterally; mandibular palp present or absent; 2–3 epipods present; dactylus of raptorial claw with 5–6 teeth, upper margin of propodus pectinate; lateral processes of fifth, sixth, and seventh thoracic somites not bilobed, process of fifth somite a broad, curved spine; abdomen broad, submedian carinae present; telson with apices of submedian teeth fixed; basal prolongation of uropod with at most tubercles on inner margin.

TYPE-SPECIES.—*Squilla scorpio* Latreille, 1825.

DISCUSSION.—Two species of *Cloridopsis* occur in the northwestern Indian Ocean, and both are reported herein from West Pakistan. They may be differentiated by means of the key given below.

Key to *Cloridopsis* from West Pakistan

Lateral process of fifth thoracic somite with a large black spot; apex of rostral plate narrow . . . . . **C. scorpio**

Lateral process of fifth thoracic somite lacking a large black spot; apex of rostral plate broad . . . . . **C. immaculata**

13. *Cloridopsis scorpio* (Latreille, 1825)

FIGURES 14*a–e*

Squilla scorpio.—Kemp, 1913, p. 42, pl. 2 (fig. 30).—Holthuis, 1941, p. 243 [older references].—Tiwari and Biswas, 1952, p. 353.—Baig, 1954, p. 143.—Chhapgar and Sane, 1968, p. 44 [key].

MATERIAL.—2 ♀, 72 mm (1 broken); off Karachi; University of Karachi.—1 ♂, 81 mm; off Karachi; Mohammed Abdullah el Husseini; USNM.

DESCRIPTION.—Eye small, cornea bilobed, broader than stalk and set obliquely on it; ocular scales rounded laterally, separated by median indentation; rostral plate as long as broad, narrowed anteriorly, apex truncate, with median carina on anterior half; carapace narrowed anteriorly, anterior width slightly less than one-half median length; anterolateral spines of carapace strong but not extending to base of rostral plate, each spine with a rounded ventral lobe; median carina of carapace lacking anterior bifurcation, intermediate carinae

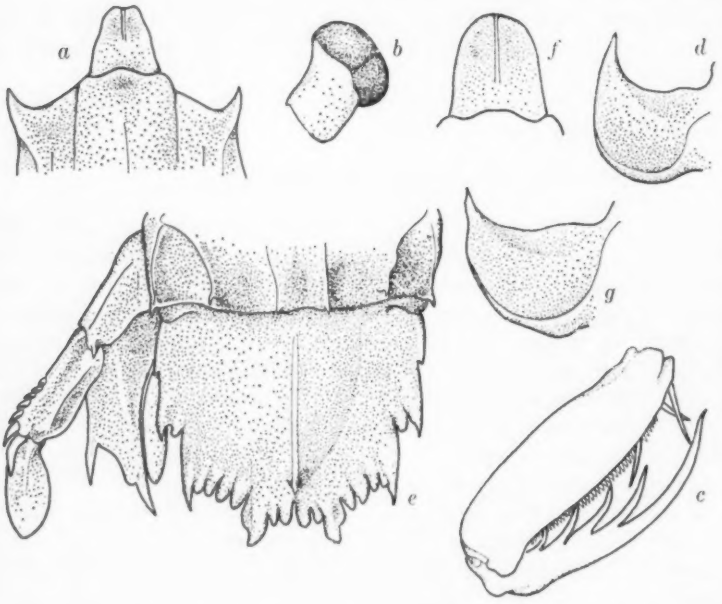

FIGURE 14.—*Cloridopsis scorpio* (Latreille), female, TL 72 mm, off Karachi: *a*, anterior portion of carapace and rostral plate; *b*, eye; *c*, propodus and dactylus of raptorial claw; *d*, lateral process of fifth thoracic somite; *e*, last abdominal somite, telson, and uropod (setae omitted). *Cloridopsis immaculata* (Kemp), female, CL 16.5 mm, off Karachi: *f*, rostral plate; *g*, lateral process of fifth thoracic somite.

present, poorly marked, not extending to anterior margin of lateral plates; dactylus of raptorial claw with 5 teeth, outer margin of dactylus sinuous, with shallow proximal notch; dorsal ridge of carpus undivided; mandibular palp absent; 2 epipods present; lateral process of fifth to seventh thoracic somites each composed of a single lobe, that of fifth somite broad, produced into an anteriorly directed spine; lateral processes of next 2 somites triangular, rounded posterolaterally; last 3 thoracic somites with submedian and intermediate carinae,

intermediates unarmed; submedian carinae present on abdomen; abdominal carinae spined as follows: submedian 6, intermediate 5–6, lateral 5–6, marginal 2–5; telson broader than long, with 3 pairs of marginal teeth, submedians fixed, prelateral lobes present, denticles large, rounded, 2, 3–4, 1; postanal keel absent; outer margin of uropodal exopod with 7 short, movable spines; lobe on outer margin of inner spine of basal prolongation of uropod large, rounded.

COLOR.—Lateral process of fifth thoracic somite with large, well-marked black spot; last 3 thoracic and all abdominal somites with dark posterior line; second abdominal somite with rectangular dorsal patch of dark color; proximal segment of uropodal exopod with dark spot.

DISCUSSION.—Living or freshly caught specimens of *C. scorpio* can immediately be recognized by the presence of the black spot at the base of the lateral process of the fifth thoracic somite; the spots can persist for many years in preservative. *Cloridopsis immaculata*, which is discussed below, lacks these black spots and exhibits other differences as well.

One of the specimens has only three intermediate denticles on one side of the margin of the telson although there is an indication of a fourth denticle appressed to the outer margin of the submedian tooth. Kemp (1913) reported three to six intermediate denticles in his material.

DISTRIBUTION.—Indo-West Pacific region, throughout the Indian Ocean into the western Pacific. Both Kemp (1913) and Baig (1954) have reported the species from Karachi.

14. *Cloridopsis immaculata* (Kemp, 1913)

FIGURES 14*f*, *g*

Squilla scorpio var. *immaculata* Kemp, 1913, p. 45, pl. 2 (fig. 31).

MATERIAL.—1 fragmented ♀, CL 16.5 mm; off Karachi; University of Karachi.

DISCUSSION.—This specimen is so fragmented that it is not possible to prepare a description, but from what we can see of the specimen it agrees well with Kemp's account. Kemp treated this species as a "variety" of *Squilla scorpio*, but there seems to be no good reason not to recognize it as a distinct species. Both species are distinct throughout their range.

Cloridopsis immaculata differs from *C. scorpio* as follows: (1) the rostral plate is longer and has a broader apex; (2) the median and lateral carinae of the carapace are more distinct; (3) the lateral processes of the sixth and seventh thoracic somites are slightly more upturned; and (4) the lateral process of the fifth thoracic somite is never marked with a conspicuous black spot.

DISTRIBUTION.—Northern Indian Ocean. It was recorded from Karachi by Kemp (1913) but is known from no other localities in the Arabian Sea.

Oratosquilla Manning, 1968

DIAGNOSIS.—Eye large, cornea bilobed, noticeably broader than stalk; ocular scales separate; carapace rounded posterolaterally; mandibular palp usually present; 4 epipods present; dactylus of raptorial claw with 5 or more teeth (usually 6), upper margin of propodus pectinate; lateral processes of fifth, sixth, and seventh thoracic somites bilobed; abdomen with paired submedian, intermediate, and lateral carinae; telson with fixed apices on submedian teeth; basal prolongation of uropod with at most serrations or tubercles on inner margin.

TYPE-SPECIES.—*Squilla oratoria* de Haan, 1844.

DISCUSSION.—Nine species of *Oratosquilla* have been recorded from the northwestern Indian Ocean; three of these are recorded herein from West Pakistan. The other species which are known from the general area are: (1) *O. quinquedentata* (Brooks, 1886), reported from Bombay by Kemp (1913); (2) *O. investigatoris* (Lloyd, 1907), reported from the Persian Gulf by Kemp (1913) and the South Arabian coast by Chopra (1939); (3) *O. gonypetes* (Kemp, 1911), recorded from the Persian Gulf by Kemp (1913) and the Gulf of Oman by Chopra (1939); (4) *O. perpensa* (Kemp, 1911), reported from the Persian Gulf by Kemp (1913); (5) *O. massavensis* (Kossmann, 1880) from the Red Sea (records summarized by Holthuis, 1967b); and (6) *O. simulans* (Holthuis, 1967) from the Red Sea.

Kemp (1913) also reported *O. woodmasoni* (Kemp) and *O. massavensis* from localities in the western Indian Ocean; those specimens are probably referable to *O. hesperia* (Manning) (see below).

All three of the species discussed below are extremely abundant in the waters off West Pakistan; most of the specimens were obtained at the local fish market in Karachi.

Key to *Oratosquilla* from West Pakistan

1. Median carina of carapace distinct throughout its length, bifurcation open posterior to dorsal pit; anterior lobe of lateral process of sixth thoracic somite with apex truncate . . . . . **O. nepa**
   Median carina of carapace either interrupted or indistinct anteriorly; anterior bifurcation, if present, open anterior to dorsal pit; anterior lobe of lateral process of sixth thoracic somite with apex acute 2
2. Anterior width of carapace less than one-half median length; lobe on outer margin of inner spine of basal prolongation of uropod rounded, margin convex . . . . . **O. interrupta**
   Anterior width of carapace more than half median length; lobe on outer margin of inner spine of basal prolongation of uropod sharp, acute, margin concave . . . . . **O. hesperia**

15. *Oratosquilla nepa* (Latreille, 1825)

FIGURE 15

Squilla nepa.—Kemp, 1913, p. 60, pl. 4 (fig. 49).—Chopra, 1934, p. 23.—Holthuis, 1941, p. 245 [older references].—Barnard, 1950, p. 847, figs. 1b, 2a.—Kurian, 1954, p. 85.—Holthuis, 1967b, p. 7.—Manning, 1968b, p. 31, fig. 10.—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—6 ♂, 72–93 mm; 6 ♀, 53–83 mm (in 8 lots); off Karachi; University of Karachi.—2 ♂, 75–92 mm; 1 ♀, 80 mm; same; USNM.—1 ♂, 99 mm; off West Pakistan; A. H. Qadri; USNM.

DESCRIPTION.—Eye of moderate size, cornea bilobed, set almost transversely on stalk, cornea width less than length of stalk; ocular scales subquadrate or rounded, inclined laterally; rostral plate subquadrate, tapering distally, apex truncate or rounded, lateral margins upturned, obscure median tubercle occasionally present; anterior bifurcation of median carcina of carapace uninterrupted, bifurcation opening posterior to dorsal pit, secondarily closing anterior to pit in some specimens; intermediate carinae of carapace not extending to anterior margin, converging anteriorly with laterals; anterolateral spines of carapace strong, extending to or beyond base of rostral plate; dactylus of claw with 6 teeth, outer margin sinuous; dorsal ridge of carpus irregular, with 2–3 large tubercles; inferodistal angle of merus with blunt spine; mandibular palp present; 4 epipods present; last 3 thoracic somites rough, pitted, with submedian and intermediate carinae, neither armed, intermediates pitted; anterior lobe of lateral process of fifth thoracic somite a slender, anteriorly directed spine, posterior lobe shorter, slender, apex acute but rounded; lateral processes of next 2 somites bilobed, anterior lobe on sixth somite large, obliquely truncate, posterior lobe larger, triangular, apex blunt, anterior lobe of lateral process of seventh somite an acute but rounded lobe, posterior lobe larger, triangular, apex rounded; abdomen rough, pitted, surface irregular; abdominal carinae spined as follows: submedian 4–6, intermediate 3–6, lateral 2–6, marginal 1–5; telson flattened, about as long as broad, with 3 pairs of marginal teeth, submedians and intermediates slender, elongate; prelateral lobes present; denticles large, rounded, 2–4, 6–9, 1; dorsal surface of telson, either side of median carcina, with lines of pits, but lacking rows of tubercles or carinae except for carinae of marginal teeth; long postanal keel present; uropod with 8–9 short, movable spines on outer margin of proximal segment; lobe on outer margin of inner spine of basal prolongation of uropod low, rounded, margin concave.

COLOR.—Most specimens faded in preservative; some show traces of dark, rectangular patches on the second and fifth abdominal somites; uropod with dark color on exopod at articulation of distal

segment, inner half of distal segment dark, endopod dark distally. Fresh specimens may be brightly colored, with the median carina of the carapace red, remainder of carinae and grooves on the carapace light green or orange; display patch on merus of claw light blue with green anterior border; carinae of abdomen light green, some with distal portions orange or red; carinae of telson green, apices of median carina and submedian and intermediate marginal teeth reddish; uropods marked with blue, green, yellow, and black, spines orange.

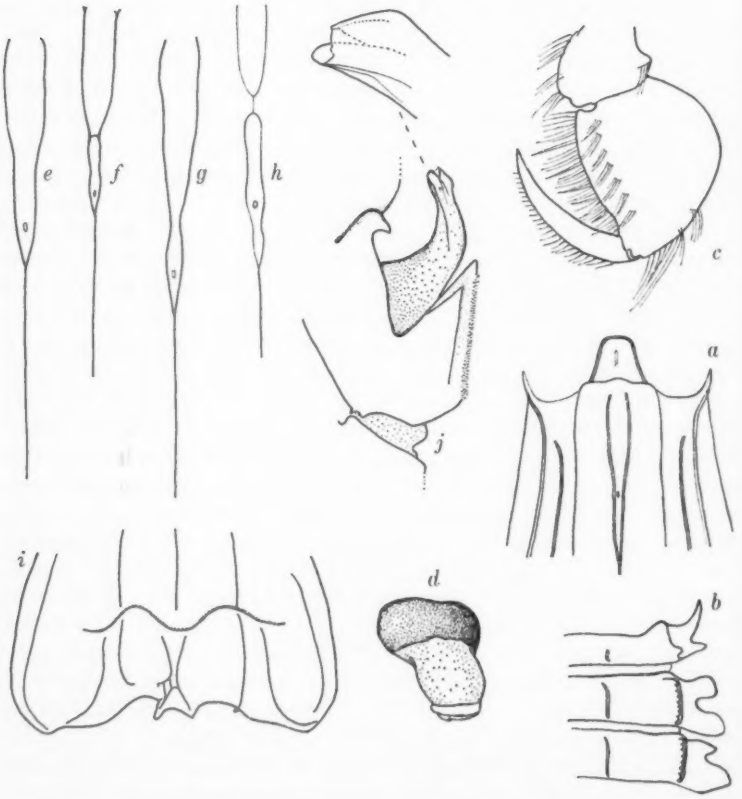

FIGURE 15.—*Oratosquilla nepa* (Latreille), male, TL 77 mm, off Karachi: *a*, outline of anterior portion of carapace and rostral plate; *b*, outline of lateral processes of fifth, sixth, and seventh thoracic somites; *c*, propodus and dactylus of third maxilliped. Male, TL 87 mm: *d*, eye; *e*, median carina of carapace. Median carina of carapace: *f*, male TL 72 mm; *g*, female, TL 79 mm; *h*, male, TL 93 mm. Female, TL 83 mm: *i*, abnormally developed posterior portion of carapace. Male, TL 93 mm: *j*, petasma.

Not all fresh specimens exhibit dark patches on the second and fifth abdominal somites, but these are well marked in a few specimens.

DISCUSSION.—The relatively small eyes, long anterior bifurcation on the median carina of the carapace, and large, truncate anterior lobe on the lateral process of the sixth thoracic somite will immediately distinguish *O. nepa* from the other two species of the genus found in the waters off West Pakistan, *O. interrupta* and *O. hesperia*. *Oratosquilla nepa* is the least abundant of the three species, but it still occurs in relatively large numbers.

Several of the specimens show unusual variation in the configuration of the anterior bifurcation of the median carina of the carapace; these variations are shown in figures 15*e–h*. The typical shape of the bifurcation is shown in figure 15*e*; in some specimens the arms of the bifurcation converge anteriorly, beyond the dorsal pit, but do not meet. In one specimen the bifurcation is closed by a short bar (fig. 15*f*). Finally, in each of a series of three specimens the bifurcation closes anterior to the dorsal pit, continues anteriorly for a short distance as a single ridge, and reopens again (fig. 15*h*). There does not seem to be any correlation of these variations with sex or size, and the specimens are typical of the species in all other respects.

Some specimens exhibit a uniform dusky-gray color pattern, whereas others show distinct rectangular patches on the second and fifth abdominal somites, suggesting a possible dimorphism in color. Kemp (1913) noted similar variation in other collections.

In one of the specimens the posterior margin of the carapace is deformed, and the median posterior projection is bifurcate (fig. 15*i*).

DISTRIBUTION.—Widely distributed in the Indo-West Pacific region, from West Pakistan and Moçambique to Hong Kong and Australia. It recorded from Karachi by Kemp (1913).

16. *Oratosquilla interrupta* (Kemp, 1911)

FIGURE 16

Squilla interrupta.—Kemp, 1913, p. 72, pl. 5 (figs. 60–62).—Chopra, 1934, p. 25.—Holthuis, 1941, p. 253 [older references].—Baig, 1954, p. 143.—Manning, 1966, p. 97, fig. 4.—Chhapgar and Sane, 1968, p. 45 [key].

MATERIAL.—1 ♀, 71 mm; off Karachi; Central Fisheries Department.—10 ♂, 88–113 mm; 5 ♀, 93–123 mm (in 7 lots); off Karachi; University of Karachi.—1 dry ♀, CL 17.2 mm; near Karachi; Mohammed Abdullah el Husseini; USNM.—1 ♂, 128 mm; West Pakistan; A. H. Qadri; USNM.—1 ♂, 100 mm; off Karachi; University of Karachi; USNM.

DESCRIPTION.—Eye large, cornea bilobed, set obliquely on stalk; ocular scales subtruncate, inclined laterally; rostral plate subquadrate, without carinae, lateral margins upturned, apex truncate; anterior bifurcation of median carina of carapace with basal interruption,

carina and arms of bifurcation distinct anterior and posterior to smooth interrupted portion; intermediate carinae of carapace not extending to anterior margin; anterolateral spines of carapace strong but not extending to base of rostral plate; dactylus of raptorial claw with 6 teeth, outer margin sinuous; dorsal ridge of carpus of claw with 2 tubercles; inferodistal angle of merus of claw with broad, blunt spine;

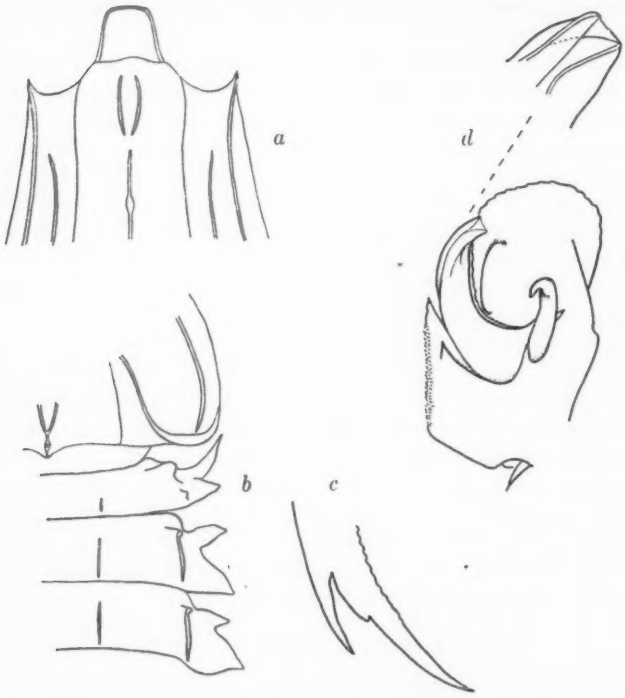

FIGURE 16.—*Oratosquilla interrupta* (Kemp), male, TL 95 mm, off Karachi: *a*, outline of anterior portion of carapace and rostral plate; *b*, lateral processes of fifth, sixth, and seventh thoracic somites. Male, TL 98 mm, off Karachi: *c*, outline of basal prolongation of uropod; *d*, petasma.

mandibular palp present; 4 epipods present; last 3 thoracic somites with submedian and intermediate carinae, none armed; anterior lobe of lateral process of fifth thoracic somite an anteriorly directed spine, posterior lobe slender, acute, directed laterally; lateral processes of next 2 somites bilobed, anterior lobe smaller than triangular posterior lobe on both somites, anterior lobe of process of sixth somite slenderer

and longer than that of seventh somite; abdominal carinae spined as follows: submedian 5–6, intermediate 4–6, lateral 3–6, marginal 1–5; telson broad, with 3 pairs of slender marginal teeth, prelateral lobes present; denticles rounded, 2–3, 7–9, 1; dorsal surface of telson lacking well-marked tubercles or ridges lateral to median carina other than short carinae of marginal teeth; postanal keel present; uropodal exopod with 8–9 movable spines on outer margin of proximal segment; lobe on outer margin of inner spine of basal prolongation of uropod rounded, margin convex.

COLOR.—Usually faded in preservative. Fresh specimens have median carina and gastric grooves of carapace red; posterior margin of carapace, last 3 thoracic somites, and first 5 abdominal somites red; median carinule and submedian and intermediate carinae of body red, color most intense on submedians; carinae of marginal teeth of telson green, apices of teeth reddish; telson with a prominent, large red or green spot on the anterior portion of the median carina; spine of uropod pink. There may be considerable variation in overall pattern.

DISCUSSION.—The specimens examined by us agree well with accounts of the species in the literature. The best feature for recognition of *O. interrupta* is the convex lobe on the outer margin of the inner spine of the basal prolongation of the uropod; in no other species is this lobe so shaped.

This is the second most abundant stomatopod taken by local fisherman off Karachi.

DISTRIBUTION.—Widely distributed in the Indo-West Pacific, from the Persian Gulf to Australia and Formosa. Both Kemp (1913) and Baig (1954) recorded its occurrence off Karachi.

17. *Oratosquilla hesperia* (Manning, 1968)

FIGURE 17

Squilla nepa.—Miers, 1880, p. 25 [part; specimen from Zanzibar].

Squilla woodmasoni.—Kemp, 1913, p. 74 [part; specimens from Zanzibar, Muscat, and Aden reidentified].

Squilla massavensis.—?Kemp, 1913, p. 76 [part; specimens from the Gulf of Oman and Persian Gulf].—Ingle, 1963, p. 15 [part; specimens from Zanzibar and the Persian Gulf reidentified].

Squilla hesperia Manning, 1968b, p. 25, fig. 8.

MATERIAL.—1 ♂, 62 mm; fish market, Fish Harbour, Karachi; 24 November 1966; University of Karachi.—6 ♂, 52–89 mm; 3 ♀, 66–101 mm (in 5 lots); off Karachi; University of Karachi.—1 ♀, 89 mm; off Karachi; University of Karachi; USNM.—1 ♀, 113 mm; off Karachi; Central Fisheries Department.—1 ♂, 89 mm; 1 ♀, 66 mm; off Karachi; Zoological Survey Department reg. no. 1877.—8 ♂, 60–80 mm; 8 ♀, 66–102 mm; 25°04′ N, 65°24–26′E; off West Pakistan; 26 m; hard packed mud; *Anton Bruun* Sta. 237A; IIOE; 22 November 1963; USNM.

DESCRIPTION.—Eye large, cornea bilobed, set obliquely on stalk; ocular scales subtruncate, inclined laterally; rostral plate as long as broad, or broader than long, trapezoidal, upturned lateral margins converging on truncate or rounded apex, median carina absent; median carina of carapace lacking well-marked anterior bifurcation; intermediate carinae of carapace not extending to anterior margin; anterolateral spines of carapace well developed but not extending to base of rostral plate; dactylus of raptorial claw with 6 teeth, outer margin sinuous; dorsal ridge of carpus of claw with large, irregular tubercles; inferodistal angle of merus of claw with broad, obtuse projection; mandibular palp present; 4 epipods present; last 3 thoracic somites with submedian and intermediate carinae, none armed; anterior lobe of lateral process of fifth thoracic somite a slender, anteriorly directed spine, posterior lobe short, slender, apex rounded, directed laterally; anterior lobe of lateral process of sixth thoracic somite slender, posterior lobe much larger, triangular, apex acute but not spiniform; anterior lobe of lateral process of seventh thoracic somite more obtuse than on sixth, posterior lobe similar to that of sixth somite; second to fifth abdominal somites with anterior tubercles between intermediate and lateral carinae; abdominal carinae spined as follows: submedian (3–4) 5–6, intermediate 3–6, lateral (1) 2–6, marginal 1–5; telson broad, with 3 pairs of marginal teeth, submedians and intermediates slender, sharp; prelateral lobes present; denticles rounded, 2–4, 7–9, 1; dorsal surface of telson roughened, with submedian row of tubercles converging under posterior apex of median carina, lateral surface between lines of pits raised, irregular, almost carinate; margin of telson in males more swollen than in females; postanal keel present; uropod with 8–9 movable spines on outer margin of proximal segment of exopod; basal prolongation of uropod with small rounded lobe, margin concave, on outer margin of inner spine in adults, lobe spiniform in juveniles and subadults.

COLOR.—In preservative, carapace with median oval patch and posterior dark line, body segments each with posterior dark line; second and fifth abdominal somites with broad, dark median patch; narrower on fifth somite; uropodal exopod with dark spot at articulation of distal segment, inner half of distal segment dark; distal half of endopod dark.

Color in living specimens may be bright and variable; there is also evidence of sexual dimorphism in color of the telson. The carinae and gastric grooves of the carapace are orange, and the posterior margin is orange and yellow. The submedian carinae of the abdomen are orange, and each abdominal somite is lined posteriorly with orange; other carinae are blue or green anteriorly, more yellow posteriorly, and the intermediate and lateral carinae of the sixth

somite are green. In females, the telson carinae and margins are primarily orange, whereas in males they are green and blue green.

DISCUSSION.—Manning (1968b) described *O. hesperia* from a single female taken off Madagascar. In his account, he pointed out that *O. hesperia* was very similar to *O. massavensis* in general appearance and he suggested that records of *O. massavensis* from localities south of the Red Sea actually might be referable to *O. hesperia*. Examination

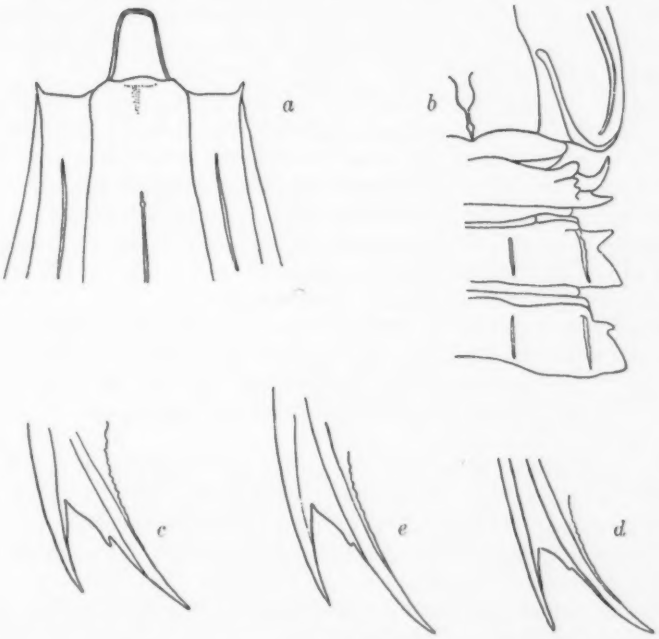

FIGURE 17.—*Oratosquilla hesperia* (Manning), female, TL 92 mm, off Karachi: *a*, outline of anterior portion of carapace and rostral plate; *b*, lateral processes of fifth, sixth, and seventh thoracic somites. Basal prolongation of uropod: *c*, male, TL 52 mm; *d*, female. TL 92 mm; *e*, female TL 101 mm.

of specimens in the British Museum from Zanzibar (1♂, 104 mm; 1♀, 75 mm; not registered), Muscat (1♂, 34 mm; reg. no. 87–16), and Aden (1♂, 42 mm; reg. no. 1894.5.16.4), all of which are *O. hesperia* rather than *O. massavensis*, bear out this suggestion.

Oratasquilla hesperia differs from *O. massavensis* in several important features as follows: (1) the rostral plate is shorter and broader, and the lateral margins are rarely markedly concave as in *O. massavensis;* (2) the submedian carinae of the abdomen are divergent on each so-

mite rather than subparallel; (3) there is a dark patch of chromatophores on both the second and fifth abdominal somites; and (4) there are many less tubercles on the telson (in *O. massavensis* there are two rows of erect tubercles flanking the median carina, one row on each side of the convergent lines of pits; in *O. hesperia*, only the inner of these two rows is well developed; the tubercles on the anterior half of the lateral surface of the telson, which are present in *O. massavensis*, are rarely developed in *O. hesperia*).

The two dark dorsal patches on the abdomen are not visible on the type; they are not always visible on the specimens from Karachi reported herein.

Both *O. hesperia* and *O. massavensis* resemble *O. woodmasoni* (Kemp) in several features, but both of the former species can be distinguished from *O. woodmasoni* by the presence of dorsal tubercles on the telson and by the well-developed lobe on the inner spine of the basal prolongation of the uropod. All three species have a smooth, polished carapace, lacking a well-developed anterior bifurcation on the median carina, and in all three the anterior width of the carapace is greater than half the median length of the carapace.

Small specimens of *O. hesperia* have a sharp spine instead of a rounded lobe on the inner spine of the basal prolongation of the uropod; in adults the lobe is rounded and may be very inconspicuous. The lobe is illustrated in figures 17*c–e* for three specimens, TL 52, 92, and 101 mm.

In adult males (TL 75 mm or more) the margin of the telson is noticeably more inflated than in the females. The denticles and carinae of the teeth may all be affected by the enlargement.

Oratosquilla hesperia is the most abundant stomatopod in the fishing grounds off Karachi.

DISTRIBUTION.—Western Indian Ocean, from Muscat, Aden, West Pakistan, Zanzibar, and Madagascar.

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